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THE SCHOPPER CHONDROMETER AND THE ESTIMATION OF THE BUSHEL WEIGHT OF WHEAT STANDARD.

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Consequent upon the importance attached, in commercial circles, to the value of the bushel weight of wheat as the basis of buying and selling it, and as the result of a desire in the wheat trade to bring about uniformity in the method of estimating that of the Australian f.a.q. standard, three of the wheat exporting firms, namely, Messrs Bunge (Aust.), Pty. Ltd., John Darling & Sons Ltd., and Louis Dreyfus & Co. presented a one litre Schopper chondrometer to the Chambers of Commerce in each of the four wheat exporting States, *i.e.*, New South Wales, Victoria, South Australia and Western Australia. The gifts were made so that each State might make the estimation in the same way. In two States a bushel measure was being used; in the others, an Australian standard or other type of chondrometer.

The Schopper chondrometer was chosen for the purpose mentioned, because a larger Schopper instrument of 20 litre capacity is used by the London Corn Trade Association for determining the bushel weight of wheat cargoes sold under one of its numerous contracts in which the weight per bushel is one of the integral conditions of the transaction. Further, this instrument as well as the one litre measure are instruments which have received the endorsement of the German Imperial Standards Commission (Kaiserliche Normal Eichungskommission) for the accurate determination of the weight of a given volume of grain. By the use of correction tables all weights are converted to terms of kilograms (1,000 grams) per hectolitre (100 litres). This has been done because Continental transactions in wheat are based upon its weight in kilograms (2.2 lb.) per hectolitre (2.75 bus.) just as the British method is based upon pounds per Imperial bushel. Having determined the number of kilos per hectolitre, the operation of converting this weight to pounds per bushel is simply a matter of proportion.

The Schopper one litre chondrometer.

The Schopper litre chondrometer presented to the Perth and Fremantle Chambers of Commerce is numbered 31947, and is 1/20th the capacity of that used by the London Corn Trade Association. It is obviously intended to be portable and is so designed that its component parts can be dismantled and packed into a drawer in the balance case. This case also forms the stand on which the chondrometer is fitted up for working purposes.

The instrument (see Fig. 1) is of brass and consists of a *column* (C), the bottom of which is shaped dovetail fashion to fit snugly into a slightly converging groove in the *base*. A bracket (Br.) 3 inches long projects from the top of the column at an angle of about 45 degrees from the vertical, and serves as the suspension arm which carries the hook from which the balance beam is suspended by means of a ring. The balance beam, with equal arms, is supported by a knife edge in the centre which rests on a seat. From the end of the left arm is suspended

Fig. 1.

The Schopper one litre chondrometer.

the cylindrical *measure* of one litre capacity (dimensions 8.805 cm. diameter by 16.49 cm. depth), and from the end of the other arm a circular pan (B.P.) (diameter 13.0 cm. = 5.1 inches) upon which weights are placed. Both the measure and pan are attached to the arms of the balance beam by hooks fitting in rings which are supported on knife edges. Associated with the measure is a *piston*, in the shape of a closed short cylinder 39 mm. (= 1 9/16th inches) deep. This fits accurately into the cylinder and is provided to drive out the air before the grain as it falls into the measure.

The measure is of special construction. The cylinder fits into a specially constructed and strengthened bottom which is perforated, and which also carries three lugs projecting outwards and below the bottom. When in operation the lugs rest upon a low brass pedestal (Pd.) placed on the top of the box, and are so placed that the perforated bottom is raised about ⅛ inch above the pedestal to allow air to escape as the *piston* falls during the filling of the measure. The lugs are slotted and fit over three brass studs which are set on the base of the pedestal and thus ensure that the measure is firm during the manipulation. The litre mark on the measure is defined by a slit 1 mm. (1/25th inch) in width and the upper structure of the measure (above the slit) which is necessary for filling and striking is carried by a casting fixed to the measure.

A V-shaped knife or *striker* is made to fit accurately into the slit at the litre mark of the measure so that a volume of 1 litre is accurately struck when the striker is forced through the cylinder of grain.

To ensure that the measure shall always be filled in the same way a *hopper* is provided to fit snugly on the top of the measure, and to ensure that a uniform volume of grain is used in each estimation a *scoop*, graduated to hold 1350 cc. is used to fill the hopper.

Operating the Schopper litre chondrometer.

Each time the instrument is set up it is advisable to see that it is in proper adjustment. This is done by attaching the measure containing the piston to the end of the balance arm and ensuring that it just balances the empty pan.

The following procedure is adopted in the determination of the litre weight of a sample of grain:—

1. The measure is fixed on the pedestal (Pd.) with the lugs under the heads of the studs.

2. The striker is then inserted fully into the slit and the piston placed on top of it.

3. The hopper is fitted on to the top of the measure.

4. The measured grain is now poured into the hopper by means of the scoop until it is full and a cone-shaped heap is formed upon the surface.

5. The striker is now withdrawn, the piston falls with a heavy thud, driving out the air through the perforated base, and a column of grain follows it under standard conditions of fall and impact.

6. The striker is inserted into the slit and pressed home so that the surplus grain is separated from that which accurately fills the measure to the litre mark.

7. The surplus grain in the hopper is now discarded and the hopper removed.

8. The striker is now withdrawn and the measure, now containing exactly 1 litre of grain, is weighed on the balance. The weight found is the weight of the grain in the litre measure.

9. By reference to the book of conversion tables the corresponding weights in terms of *kilograms per hectolitre* or *pounds per Imperial bushel* are ascertained.

The weight found by the Schopper litre chondrometer requires to be corrected before it can be expressed in kilos per hectolitre or pounds per bushel.

Wheat sales on the Continent of Europe are based upon the weight in kilograms (1,000 grams) per hectolitre (100 litres), so that it might be assumed that by multiplying the litre weight by 100 the result would be the weight per hectolitre in grams, and that by dividing by 1,000 the weight per hectolitre in kilograms would be obtained. Experiment has shown, however, that this is not the case; there is a well recognised divergence between the results obtained by accurate instruments of different volumes. In consequence, a correction has to be made. This is done in the conversion tables which accompany the Schopper chondrometer.

These tables are drawn up by the Kaiserliche Normal-Eichungskommission (Imperial Standards Commission) on the basis of actual experiments to correlate the ¼ litre, the 1 litre and the 20 litre Schopper chondrometers with the standard hectolitre machine. It is found that the conversion factors vary both with the machine and with the type of grain under test.

In converting the terms of kilograms per hectolitre to pounds per Imperial bushel, the Commission has used the factor 0.8013* which is calculated from the ratios of the volumes of the hectolitre and Imperial bushel and of the weights of the kilogram and pound.

The procedure with the Schopper litre chondrometer gives different results even when corrected from the W.A. standard procedure for estimating the weight of an Imperial bushel of wheat.

The Schopper chondrometer presented to the Perth and Fremantle Chambers of Commerce in this State arrived on the day set aside for the fixing of the f.a.q. standard at Fremantle this year, but was not used for the purpose.

In order that the correlation between the estimations according to the Schopper chondrometer, the Imperial bushel measure and the Australian standard chondrometer could be determined the Schopper chondrometer was borrowed by the Department of Agriculture and some 80 lbs. of wheat of the f.a.q. standard, as mixed during the official proceedings, were obtained. This sample is referred to as "*Standard*" *Wheat* in the text. The bushel weight of this parcel from the f.a.q. standard was determined by the usual method adopted in this State, using the Imperial "Standard" bushel measure (18.55 inches diameter by 8.23 inches depth) and was found to be 63¾ lb. The same weight was obtained in the "drum" Imperial measure† (14⅛ inches diameter by 14 5/32nd inches depth) using the same technique.

The parcel was then put through the mechanical divider (Fig. 2) and reduced to sub-samples each of about 1 kilo (2.2 lb.) sufficient to fill the scoop (Fig. 1) up to the mark.

*The Imperial bushel is defined in English Weights and Measures Act of 1878 as the volume occupied by 8 gallons (80 pounds weight) of distilled water at 62° F. and 30 inches of mercury pressure. At that time distilled water *containing air* was used and the volume occupied by 80 lbs. weight amounted to 2218.19 cubic inches. If this figure is adopted for the volume of an Imperial bushel the conversion factor from kilograms per hectolitre to pounds per bushel is 0.8013. In more recent determinations *air free* distilled water has been used and it is found that 80 pounds of *air free* distilled water occupy 2219.7 cubic inches. If this volume is adopted for the Imperial bushel the conversion factor is 0.8017, which is used in some tables. It is not clear which figure is *legally* correct. Scientifically, the figure using *air free* distilled water would be correct.

†The "drum" Imperial bushel measure is of the same capacity as the Imperial standard bushel, viz., 8 Imperial gallons, but of different dimensions, being narrower and deeper.

MECHANICAL DIVIDER OR SAMPLING DEVICE.

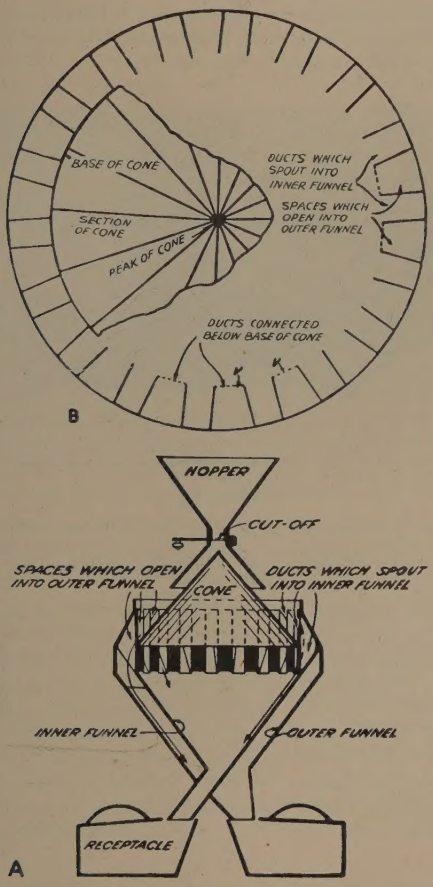

Fig. 2.

The grain flows from the hopper through an outlet controlled by a slide on to a cone which performs the actual mechanical division. To do this the cone is provided with perpendicular vanes which form ducts down which the grain flows. In this way the parcel is divided by random into as many parts as there are ducts. The device is provided with two outlet spouts, which deliver grain to their respective receptacles. The grain from one set of alternate ducts is diverted to one outlet and the grain from the remaining ducts is diverted to the other spout. In this way the parcel of grain is divided by random into two samples of equal size and delivered to their respective receptacles.

A. Vertical cross section of device showing paths taken by the grain in passing from the hopper to the receptacle.

B. Cross section of the device at the base of the cone.

The weights of three of these sub-samples were determined on the Australian Standard chondrometer No. 186 (Fig. 3), capacity one pint. In each case the weight recorded was 63¾ lb.

The weights of six sub-samples, determined on the Schopper chondrometer, were 805 grams, 805 grams, 805 grams, 803 grams, 804 grams and 805 grams, respectively, which gives an average of 804.5 grams.

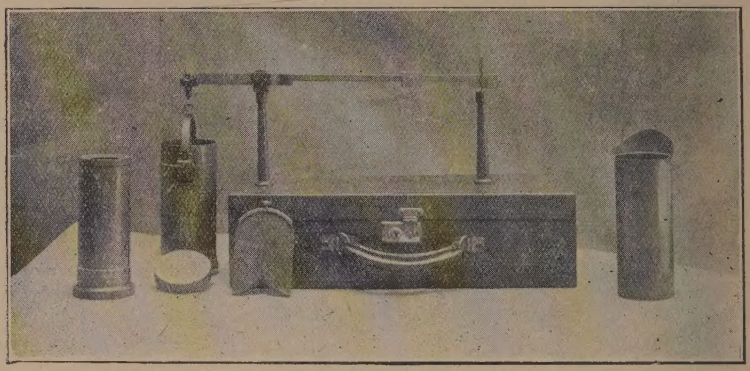

Fig. 3.

The Australian standard pint chondrometer showing measure, hopper, scoop, striking plate and piston similar to those of the Schopper chondrometer. The balance is, however, of the steelyard type instead of the beam type.

If the weight per Imperial bushel were determined as the result of calculation having regard to the relation between the volumes of the litre and bushel measures and the weights of grain and pound (factor: 0.08013) the weight would have been 64.5 lb. The discrepancy by this method of conversion is ¾ lb. per bushel. The German Imperial Standards Commission (Kaiserliche Normal Eichungskommission) have recognised that such discrepancies occur and to correct them have prepared a Handbook of Conversion Tables which is issued with the instrument. The corrected figures for 804.5 grams per litre expressed in pounds per bushel as found in the conversion tables is 65 lbs. per bushel or 1¼ lbs. more than the weight obtained under the W.A. method of weighing an Imperial bushel.

The differences are due to the character of the commercial wheat and which in consequence does not pack nor weigh the same under different methods.

The discrepancies referred to are due to two factors—(a) the varying methods used in filling the respective measures; (b) the relative size of the litre and bushel measures.

Distilled water always occupies the same volume per pound under standard conditions of temperature and pressure and is, therefore, used for standardising purposes. Thus a bushel is defined as the volume occupied by 80 lbs. of distilled water at 62° F. and 30 inches of mercury pressure. A commercial sample of wheat, on the other hand, consists of a heterogeneous mixture of grains of varying sizes, together with foreign matter such as chaff, etc. This mixture does not always pack in exactly the same way in spite of most careful methods of filling the measure and, in consequence, the weight of a definite volume is not constant when weighed several times. The variation observed is magnified when measures of different volumes are used and different methods of filling the measures are adopted.

It may be inferred from the discrepancy in the results obtained by these two methods that one or both are in error. This is not so. Each method gives the correct figure for the standardised procedure followed in each case, and to correlate the results of one method with another an allowance, based on actual experiments, has to be made. Thus Fisher and Jones (Wheats of Commerce, p. 48) find that—"The Boerner apparatus, which is the official bushel weight tester in U.S.A., gives results approximately 2 lb. per bushel lower than the best scales (*e.g.*, the Schopper, Sommer-Runge or Avery machines) in use in England. Hence in converting American figures obtained with the Boerner apparatus into English equivalents" (after allowing a further 2 lbs. per bushel for the difference in the respective volumes of the Imperial and Winchester bushel measures) "4 lb. per bushel should be added to the American figures."

The exact determination of a bushel of wheat is not nearly as easy as most persons imagine. In practice, it is difficult of achievement and furthermore the difficulties are increased when the estimation is arrived at by using a measure which is only a small fraction of the standard volume of capacity, *e.g.*, an Imperial bushel in British countries or the hectolitre in Continental ones.

As already stated, the German Standards Commission have estimated in the Handbook of Conversion Tables the weight of an Imperial bushel of wheat by multiplying the figure in terms of kilograms per hectolitre by 0.8013. It is incorrect to assume that the weight of an actual Imperial bushel measure of the wheat can be arrived at by this simple arithmetical procedure.

This fact is illustrated by experience with the McGuirk machine which is used by the Liverpool Corn Trade Association for determining the bushel weight of wheat in connection with "Futures Contracts," and on which an Imperial bushel of wheat is weighed with just as much accuracy and freedom from the personal equation as on the Schopper instrument. Duly ("Grain," p. 60) records that "the results obtained by this machine have been stated to be ¾ lb. per bushel lower than those obtained on the Schopper 20 litre instrument." Similarly with this season's W.A. wheat, the difference in the actual Imperial bushel weight determined by the Chambers of Commerce and the bushel weight calculated from weighings on the *one* litre instrument was ¾ lb. and by using the correction given in the Conversion Tables about 1¼ lbs. per bushel.

It is thus obvious that to secure uniformity of results, it is first essential to have uniformity of technique.

Lack of uniformity in results may be due to personal, instrumental, sampling and packing errors.

Duly in "Grain" points out that there are five possible sources of error. These are associated with-

1. the volume of the measure;
2. the manner in which it is filled;
3. the way in which it is levelled off or struck when filled;
4. the way in which it is weighed;
5. the relation between the size of the actual measure used and the bushel measure.

These are errors due to the personal factor in manipulation and errors in the component parts of the instrument, and are eliminated in the construction of the Schopper, the McGuirk and other standard chondrometers, and in the procedure followed in Western Australia for the fixing of the bushel weight of the f.a.q. standard.

Experience has shown that there are two other sources of error outside the instrument and the personal factor. These are—

6. sampling errors, *i.e.*, errors arising in the course of sampling the bulk parcel;
7. packing errors, *i.e.*, errors due to the way in which the same wheat packs into the measure when run in from the hopper.

To determine the magnitude of the errors due to these factors, a series of experiments was designed with four classes of wheat. With each of these classes tests were made with the "Standard" and "Drum" Imperial bushel measures, the Schopper chondrometer and the Australian Standard chondrometer. The work involved the determination of—

a. the sensitivity of the instruments;
b. packing variation;
c. sampling variation.

The sensitivity of the instruments is greater than necessary for commercial purposes.

The first part of the investigation involved the determination of the weights necessary to deflect the swing of the beams by an observable amount.

It was found that the Schopper one litre instrument was sensitive to 20 mgm. (0.0007 oz.) and the Australian standard chondrometer 186 to 50 mgm. (0.0018 oz.) placed on the measure. The Asco platform scales used for weighing the Imperial bushel was sensitive to one ounce.

Except for weighing the Imperial bushel, full advantage of the sensitivity of the instruments was not taken when making the observations. The weighings were made to 0.5 gm. per litre (0.64 oz. per bushel) on the Schopper instrument and to one ounce per bushel on the Australian standard chondrometer.

Differences in the bushel weight due to packing variation are found in separate weighings of the same sample.

It may seem somewhat surprising to find that varying bushel weights are obtained when the same thoroughly mixed parcel of some 80 lb. of the f.a.q. standard wheat is weighed several times in the same way and in accordance with the usual W.A. standard procedure. This is to be expected when it is realised that a parcel of commercial wheat is not homogeneous but consists of a mixture of grain, chaff, foreign matter, etc., and in consequence will not pack the same way on all occasions. In order to determine the extent of this packing variation, ten weighings of the same sample were made with—

1. the "Drum" bushel measure;
2. the one litre Schopper chondrometer; and
3. the Australian Standard chondrometer (1 pint).

In each case, trials were made with a commercial wheat obtained from the parcel used in the fixing of the f.a.q. standard in 1936 (designated "Standard" wheat in the text), and also with "light" wheat much inferior to the "Standard" wheat.

The mechanical analyses of these samples are given in Table 1.

TABLE 1.

Sample.	Large Grain.	Small Grain.	Thin Grain.	Total Millable.	Dockage. Foreign Matter.	Dockage. Screenings.	Total Unmillable Material.
Light weight ...	17·2	31·4	27·4	76·0	1·6	22·4	24·0
W.A. F.A.Q. ...	90·2	5·7	1·3	97·2	·3	2·5	2·8

Light wheat with much dockage has almost twice the packing variation found in standard wheat.

The results of the weighings are given in detail in Table 2.

TABLE 2.

Results obtained by determining the bushel weights of a sample of standard and of light weight wheat each ten times in the "Drum" bushel measure.

Observation.	Bushel Weight. Standard Wheat.* lbs.	ozs.	Light Weight Wheat. lbs.	ozs.
1	62	15	53	8
2	63	0	53	9
3	63	1	53	5
4	63	2	53	6
5	63	1	53	7
6	63	0	53	9
7	63	0	53	10
8	63	1	53	7
9	63	0	53	8
10	63	1	53	8
Average	63	0·5	53	7·7
Range of observation	...	3	...	5

While the range in the case of the light weight wheat is 5 ounces, almost double that observed with the standard wheat, treated statistically the figures show (Appendix Table I.) that with the standard wheat in 20 cases out of 21 the packing variation will be less than 2 ozs. (1.8 ozs.) from the average, whereas in the case of the light weight wheat the variation is 3.0 ounces per bushel.

With the Schopper one litre chondrometer and the Australian standard chondrometer, ten weighings of each of three random samples were made. The technique adopted in each case was to mix the sample thoroughly by hand before each weighing, to overcome the chance of segregation of the component parts in the course of the experiment.

To illustrate typical variations observed on the one sample the figures from the series of observations showing the greatest range on both standard and light weight wheat using the Schopper chondrometer are given in Table 3. The lowest and highest weights are shown in heavier type.

*It will be noted that the bushel weight of this sample decreased during the course of the trials owing to the severe treatment the grain received in the repeated processes of mixing and subsampling.

TABLE 3.

Observation No.	Packing Variation. Standard Wheat. Grams.	Light Weight Wheat. Grams.
1	793·5	**679·5**
2	794·5	685·0
3	**792·5**	686·5
4	794·0	687·0
5	797·5	688·5
6	797·5	687·5
7	**798·5**	**689·5**
8	797·0	685·0
9	796·0	686·5
10	795·5	687·5
Range	6·0	10·0

Parallel weighings with the Australian Standard chondrometer No. 186 showed that practically identical variations were observed with both instruments.

Following these weighings, the clean grain was separated in the case of both the standard and light weight wheats and the packing variation of the clean wheat (dockage free sample) determined on the Schopper chondrometer.

The results of all of the weighings made in this series of experiments have been treated statistically and summarised in Table I. of the Appendix.

A study of these results leads to the conclusion that—

1. the variation due to packing of the commercial grain with the litre and pint measures is approximately double that observed with the bushel measure;
2. the packing variation with light weight wheat is greater than with normal commercial grain similar to the f.a.q. standard. With the wheats used in the experiment the light weight sample gave 50 per cent. greater variation than the standard sample;
3. with clean grain (dockage free grain) of both standard and light weight samples, the variation due to packing was much less than with the commercial wheat—in both cases approximately one-half.

The packing variation, measured on the Schopper one litre chondrometer, is the same for the f.a.q. standard samples from each wheat exporting State.

By way of comparison with the Western Australian wheats the packing variation was determined on the official f.a.q. standard samples from New South Wales, Victoria and South Australia. The results, summarised in Table I. of the Appendix, closely approximate those obtained experimentally with Western Australian standard wheat.

The sampling error is of greater magnitude than the packing variation and is magnified by the use of certain sampling methods. It is increased by the use of smaller measures.

It has become an established practice in Western Australia to fix the f.a.q. standard annually by mixing wheat pro rata from the ports of Fremantle, Albany, Bunbury, Geraldton and Esperance. The wheat from each port is obtained as a running sample representing the grain received at the ports for export up to the time of fixing the f.a.q. standard.

In the past the grain, in quantity about 20 bushels, has been thoroughly mixed by hand on a sheet and the bushel weights determined of a number of samples taken from the heap, using the "Standard" Imperial bushel measure. (Fig. 4.) Each sample was taken by means of a shovel from *one* place in the heap and has been designated a *scoop* sample.

Fig. 4.
Fixing the F.A.Q. Standard in Western Australia.

During the six years 1931 to 1936, inclusive, fourteen determinations each involving duplicate or triplicate weighings were made on f.a.q. wheat from different ports and for the State. The weighings to the nearest ¼ lb. of the parcels for which duplicate or triplicate weighings were made are given in Table 4.

TABLE 4.

Bushel Weights of grain weighed by the Chambers of Commerce at the fixing of the f.a.q. standard.

Port or State.	Pounds per Imperial Bushel.		
	1931.		
Port A	62½	62¾	62¾
,, B	64	64¼	64
,, C	63¾	63¾	...
State	63½	63½	...
	1932.		
Port A	62¼	62¼	...
,, B	62¼	62¼	...
State	62¼	62¼	62¼
	1933.		
Port A	63	62¾	...
,, B	61¾	61¾	...
,, C	61	61	...
State	62¾	62¾	62¾
	1934.		
State	62¼	62¼	62¼
	1935.		
State	62¾	62¾	62¾
	1936.		
State	63¾	63¾	63¾

It will be noted that the variations during the six years have been few and those observed are of small magnitude, the greatest being ½ lb. per bushel.

As a result of preliminary observations with the one litre Schopper chondrometer, it became apparent that the sampling error was of much greater magnitude with the smaller measure and a series of experiments wa s arranged to arrive at an accurate determination of this error. Both the Schopper one litre chondrometer and the Australian Standard chondrometer (1 pint) were used.

Parcels of approximately 80 lbs. each of the standard wheat and the light weight wheat were subsampled by three different methods to give samples of about 1350 cc. volume (nearly 2½ pints) suitable for weighing on both chondrometers.

In each case the parcel of wheat before sampling was thoroughly mixed by hand. The sampling methods were—

1. By the mechanical divider. These samples were called *Divider* samples;
2. By placing the parcel in the conical hopper used for filling the Imperial bushel measure and drawing off samples of the requisite volume by opening the slide at the bottom. These were called *Flow* samples*;

* It was thought that a series of representative samples from a parcel of wheat could be obtained by thoroughly mixing the wheat by hand, placing it in the hopper used for filling the Imperial bushel measure and drawing off samples of requisite size from the bottom. The use of this method showed that definite segregation took place during the course of the sampling and that light weight samples were obtained at the end of the series. This means that the heavier fractions of the commercial grain move to the bottom faster than the light-weight material and gives further evidence of the difficulty of getting and maintaining a parcel of commercial wheat as a homogeneous mixture.

3. Samples were taken from one place by means of a scoop of the requisite volume. This represents the method of sampling used by the Grain Committee in W.A. when fixing the seasonal weight of the f.a.q. standard. These were called *Scoop* samples.

To obtain the divider samples, it was necessary to put the wheat through the mechanical divider 5 times in order to obtain samples of requisite size for the chondrometers. This gave 32 samples. One of each of the final pairs was discarded leaving 16 for the estimation. Each sample was weighed 3 times and the average taken to represent the weight of the sample.

In the case of the flow and scoop samples, these were taken from the bulk until the parcels were exhausted. Thirty-three to 40 samples were usually obtained by these methods and each sample was weighed once.

To illustrate the type of variation found Table 5 has been prepared. In this table the first, the last, the highest and the lowest weights are given and to amplify these, alternate figures are given for the divider samples, and every fifth figure for the flow and scoop samples.

TABLE 5.

Sampling errors observed by different methods of sampling.

"Scoop" Sample. Single Weighings.		"Flow" Sample. Single Weighings.		"Divider" Sample. Average of 3 Weighings.	
Weight No.	Weight in Grams.	Weight No.	Weight in Grams.	Weight No.	Weight in Grams.
1	802·5	1	801·0	1	797·0
6	797·0	**2**	**802·0**	**2**	**795·7**
11	798·0	6	798·0	3	799·7
12	**803·0**	11	797·0	**4**	**800·2**
16	799·5	16	800·0	5	799·2
21	800·0	21	800·0	7	796·0
26	787·0	26	797·5	9	797·7
31	792·5	31	792·0	11	796·7
33	**779·5**	36	794·0	13	799·2
34	781·0	**39**	**785·5**	15	796·2
		40	799·0	16	797·2

Sampling by the mechanical divider gives least sampling error.

The results given in Table II. of the Appendix show the ranges in the observations made using the different methods of sampling and the different types of wheat. These results are summarised in Table 6.

TABLE 6.

Ranges of Observations as affected by method of sampling and type of grain.

Type of Wheat.	Divider. Grams per litre.	Scoop. Grams per litre.	Flow. Grams per litre.
Standard	9	16	16·5
Lightweight	25	33·5	43
Dockage free grain ...	...	...	4

Statistical treatment of the results confirms the evidence of the figures in Table 6 and shows that the expected limits of variation of any one sample from the true average, 20 out of 21 observations, would be as given in Table 7.

TABLE 7.

Limits of Maximum Variation from the true average to be expected for any one sample 20 times out of 21, using different methods of sampling and different types of wheat.

Type of Wheat.	Type of Sampling.		
	Divider.	Scoop.	Flow.
	± ozs.	± ozs.	± ozs.
Standard	3·8	15·0	11·0
Lightweight	13·8	23·6	30·4
Dockage free ...	...	...	2·8

It will be seen from these results that the magnitude of the sampling error is affected by at least two factors—

1. The method of obtaining the sample;
2. The nature of the sample.

There is no doubt that, for both types of wheat, the mechanical divider is by far the most effective and gives an error with commercial grain of less than half that obtained by the other methods. The error observed, using the divider method and standard wheat, was such that for any single weighing there are 20 chances in 21 that it will fall within 4 to 5 ounces of the true average, and if ten samples taken by this method are weighed the error to be expected would be within 1 to 1.5 ounces of the true average. Using three weighings per parcel the error obtained would be expected to be within at most 2 to 3 ounces of the true weight per bushel. For purposes of comparison the complete results were treated statistically and summarised in Table II. of the Appendix.

The "scoop" sampling and the "flow" sampling methods are liable to an error amounting to from 2 to 4 times as great as the divider method when considered on the same basis. This conclusion from statistical treatment is supported by the range in the values of the observations made in each case.

The cleaner the grain the smaller will be the sampling error.

The figures in Tables 6 and 7 and in Table II. of the Appendix show that the sampling error is greater with light weight and chaffy wheat than with standard wheat or dockage free grain. Light weight wheat is liable to a sampling error up to 2 to 4 times as great as that observed with standard wheat.

The New South Wales f.a.q. Schopper weights confirm the Western Australian conclusions regarding "sampling errors."

In fixing the f.a.q. standard in New South Wales 10 samples of both bulk and bagged wheat were weighed on the Schopper one litre chondrometer. These showed a range of from 64.2 lbs. to 65.0 lbs. for bagged wheat and from 64.1 lbs. to 64.6 lbs. It will be seen that the sampling error was of similar order of magnitude but somewhat higher than obtained with the mechanical divider in these experiments with W.A. f.a.q. wheat.

Uniformity is commercially advantageous.

As recognised by the donors of the instruments, there can be no question of the desirability of adopting uniform procedure by all parties to secure comparable results for use as the basis of any commercial transactions. At present there is no uniformity of procedure in the Australian grain trade.

It is quite evident from the results of these experiments, and from previous experience elsewhere, that a greater weight per bushel is obtained with the Schopper instruments than with the McGuirk instrument, or the method adopted by the Grain Committee of W.A. As Australian wheat is sold according to one of the numerous contracts of the London Corn Trade Association, and as that authority uses a Schopper instrument for determining the bushel weight of wheat sold under its contracts, it follows that it is desirable that the bushel weight of Australian wheat should be determined by an instrument which gives the same results. Unless this is done Australian wheat is likely to suffer by comparison with that of its competitors, who recognise the London Corn Trade Association as the controlling authority, and use its contracts and standards for selling purposes.

A weakness of the present proposal is that the instruments to be used in Australia are not uniform with that of the controlling authority. This weakness is easily overcome.

If the Schopper technique is to be adopted it is necessary to consider what instrument should be used. There are two objections to the use of the one litre Schopper instrument for the purpose. In the first place it is not the standard used by the London Corn Trade Association, which is the 20 litre Schopper instrument. In the second place this investigation shows that the risk of errors due to packing variation and sampling errors is magnified by the use of the smaller measure. It is considered that the smaller type of instrument is of value principally for the field determination of bushel weights, and it appears that the one litre (and also the ¼ litre) Schopper instrument was designed for this purpose. The fundamental objection to the use of the smaller instrument and to avoid the necessity of purchasing an expensive outfit could be overcome if each State secured a 20 litre measure of the same dimensions as that used in the 20 litre Schopper instrument, and followed the technique adopted in estimating the bushel weight by the Schopper system.

The standard 20 litre Schopper instrument admirably meets the requirements of a controlling association, such as the London Corn Trade Association, whose work is international in character and concentrated at one centre, and, in consequence, has regular use for it. In Australia the position is different as the f.a.q. standard is fixed only once in each year in each State and the expenditure, amounting to about £400 (Australian currency) for such instrument, would not be justified. Nor is it necessary. The same results could be secured by filling the 20 litre measure from a hopper of the same size and shape as that used in the standard machine. The outlet of the hopper would be the same size as in the standard machine and arranged at the same height above the top of the measure. The striking could be done carefully by hand. In taking the sample for weighing great care would also have to be exercised, the division preferably being made with a mechanical divider. This would apply equally to the London machine as to the 20 litre measure suggested for Australian practice.

The Schopper one litre chondrometer is less suitable for Australian conditions than the Australian Standard chondrometer, which is identical in principle.

The design of the one litre Schopper chondrometer is not nearly as suitable for commercial work in the shed or field as the Australian standard type. While the technique adopted for filling the measure is practically identical with both instruments, and both thus minimise personal and manipulation errors, the weighing is done on a beam balance, using weights, in the Schopper system, and on a steelyard type of balance with the Australian standard chondrometer. For field work the steelyard type of balance presents considerable advantages. Though not

quite as sensitive as the Schopper, the Australian standard chondrometer is sensitive enough for practical purposes and can be read to 2 ozs. per bushel; by taking special care readings to 1 oz. per bushel can be made.

At present the scale on the steelyard synchronises with the weights obtained with the Imperial bushel measure as used in Western Australia, and closely approximates the results obtained with the McGuirk machine. The Australian standard chondrometer could be made to synchronise with the Schopper instruments (which give higher bushel weight figures) by either of two methods. The steelyard could be calibrated to correspond with the Schopper weights, or a conversion table could be provided to correct the readings of the present scale for the discrepancy between the Schopper and the present Australian system. Probably the most convenient commercial method would be to compare the readings obtained with the 20 litre measure and the Australian standard chondrometer at the time the f.a.q. standard is fixed, and then to decide upon a correcting weight to be added to the readings of the standard chondrometer during that season.

"Futures" contracts may require that the weight per bushel of the f.a.q. standard according to the McGuirk procedure be also determined each year.

The Liverpool Corn Trade Association is the controlling authority for "Futures Contracts" and, as the basis of these transactions, uses the bushel weight as found on the McGuirk machine. Its readings are lower than those of the Schopper instruments. These latter are, therefore, obviously unsuitable for transactions in "futures." If the Australian wheat trade requires standards for such transactions it will be necessary to provide also a standard based upon the bushel weight found by the McGuirk machine.

Neither the 20 litre nor the 1 litre Schopper instruments are suitable for this purpose. Both, with and without the corrections, give results higher than that of the McGuirk machine, and to use these would obviously be calamitous to Australian traders interested in such transactions. It may be necessary, therefore, under these conditions to fix two bushel standards at the annual fixture, viz., one for current trade by means of the 20 litre measure and the other for "futures" by means of the bushel measure. The controlling authority uses a McGuirk machine, and, in consequence, the Australian procedure should be uniform and conform to the method followed by that authority. The New South Wales Chamber of Commerce has such a machine and could use it. The other States need not purchase expensive instruments, but could obtain the uniform and comparable results by the use of a bushel measure of the same shape and dimensions and by filling it from a hopper of the same design and dimensions, the outlet of the hopper being of the same size and fixed at the same height above the top of the measure.

It is believed that the Australian standard chondrometers are calibrated to conform with the readings of the McGuirk machine, but, if not, any slight difference in this connection could be corrected.

Comparative results obtained on the Schopper one litre and Australian chondrometers of the f.a.q. standards of the Australian exporting States.

In view of the desire for a comparison on a uniform basis of the trading standards of each of the Australian wheat exporting States the results in Table 8 hereunder will be of interest. These results were obtained from representative samples of the f.a.q. standards distributed by the Chambers of Commerce in each State, and will be liable to a sampling error similar to that observed in our investi-

gations. It will be seen from these figures that the weights of the New South Wales sample determined in Western Australia are slightly different from the weighings of the official samples taken at the time of fixing the fa.q. standard in Sydney. In this connection it may be pointed out the average weight of ten samples ascertained in New South Wales, when fixing the f.a.q. standard with the one litre chondrometer, is slightly different from that obtained on a similar instrument in this State. The differences were—for bagged wheat 8 ozs. and bulk wheat 3 ozs. per bushel. The separate weighings of the single samples available from each State, when treated statistically (Table I. of the Appendix) are in conformity with these results obtained in the experiments regarding the packing error.

TABLE 8.

F.A.Q. State Standards, 1935–36.

State.	Bushel Weight, Commercial Grain. By Schopper chondrometer (from conversion table).	By Standard chondrometer.	Percentage dockage.	Dockage free grain, bushel weight by Standard chondrometer.
N.S.W., Bulk ...	64·6	$63\frac{1}{4}$	3·91	$63\frac{2}{16}$
N.S.W., Bulk* ...	64·4	...	...	...
N.S.W., Bagged ...	65·2	$63\frac{3}{4}$	3·46	$63\frac{15}{16}$
N.S.W., Bagged* ...	64·7	...	...	...
Victoria	64·9	$63\frac{5}{8}$	2·51	$63\frac{11}{16}$
South Australia ...	64·1	$62\frac{13}{16}$	2·81	$63\frac{1}{2}$
Western Australia...	65·0	$63\frac{3}{4}$	2·80	$64\frac{1}{4}$
Light weight ...	54·1	$53\frac{5}{8}$	24·05	$56\frac{2}{16}$

* The average of 10 samples weighed on the Schopper chondrometer by the N.S.W. Committee.

APPENDIX.

The statistical treatment of the results.

In order the facilitate the study of the results of the experiments the usual statistical treatment was applied. Standard deviations (S.D.) were determined on all sets of weighings as this gives a measure of the variability of the results irrespective of the number of observations made. Furthermore, the standard deviations afford a good basis for the comparison of the variability of the observations within each set.

The arithmetical method used was the adoption of a convenient working mean (W.M.) and the determination of the sum of the squares of the deviations from this mean (Σd^2). The true standard deviation (S.D.) is obtained by subtracting from this sum (Σd^2) the following product :—[grand total (G.T.) minus working grand total (W.G.T.)] multiplied by [true mean (T.M.) minus working mean (W.M.)], dividing the result by the number of observations minus one (n—1) and then taking the square root of this answer.

The formula, therefore, is :—

$$\text{S.D.} = \sigma = \frac{\sqrt{\Sigma d^2 - [(\text{G.T.} - \text{W.G.T.}) \times (\text{T.M.} - \text{W.M.})]}}{\sqrt{n - 1}}$$

If it be assumed that the observations fall on a normal distribution curve the chances of any variation from the true mean can be calculated. For general experimental work it is usually accepted that a variation from the mean is significant, and probably not due to chance errors, if it is likely to occur more frequently than *once* in 21 observations. The range of variation for any single observation on these odds (1 in 21) is approximately twice the standard deviation. In Table II. of the appendix and Table 7 of the text this figure, twice the standard deviation, is given to indicate the range about the true mean within which any single observation may reasonably be expected to fall. If the average of several observations is being considered, the standard deviation of this mean, which is known as the standard error, is obtained by dividing the standard deviation by the square root of the number of observations included in the average.

TABLE I.

The effect of the type of instrument used and the type of wheat under test upon the magnitude of the packing variation in the determination of the bushel weight of wheat.

Type of Wheat.	Experiment No.	Schopper one-litre chondrometer.					Australian standard chondrometer, 186.		"Drum" bushel.		Difference between the Schopper estimate and the estimates with the Australian instruments. (lb. per bushel.)
		Mean Weight average of 10 observations. (gm. per litre.)	Range of observations. (gm.)	S.D. (± gm.).	Mean Weight from conversion tables. (lb. per bushel.)	S.D. (± oz.).	Mean Weight average of 10 observations. (lb. per bushel.)	S.D. (± oz.).	Mean Weight average of 10 observations. (lb. per bushel.)	S.D. (± oz.).	
		gm.	gm.	gm.	lb.	oz.	lb.	oz.	lb.	oz.	lb.
Western Australian— Standard	1	800·8	799·5—802·5	1·10	64·6	1·4	...	...	63·03	0·88	...
	2	799·2	797·0—800·5	1·16	64·5	1·5	...	...	...	...	...
	3	795·6	792·5—798·5	1·99	64·2	2·5	...	...	...	...	...
	Average	798·5	...	1·42	64·4	1·8	...	...	63·03	0·88	1·4
Dockage free grain ...	1	802·3	800·5—804·0	1·10	64·8	1·4	63·58	1·2	...	...	1·2
	2	805·0	804·0—806·0	0·62	65·0	0·8	63·62	1·4	...	...	1·4
	3	805·9	805·0—807·0	0·70	65·1	0·9	63·68	1·0	...	...	1·4
	Average	804·4	...	0·81	65·0	1·0	63·6	1·2	...	...	1·4
Light weight	1	686·2	679·5—689·5	2·75	54·4	3·5	...	...	53·48	1·49	...
	2	684·0	681·5—686·0	1·66	54·3	2·1	...	...	...	...	...
	3	684·6	681·0—688·0	2·00	54·3	2·6	...	...	...	...	...
	Average	684·9	...	2·14	54·3	2·7	...	...	53·48	1·49	0·8
Dockage free grain ...	1	715·5	712·5—716·5	1·25	57·1	1·6	56·58	1·3	...	...	0·5
	2	716·2	715·0—718·0	1·05	57·1	1·3	56·63	2·2	...	...	0·5
	3	715·2	713·5—716·5	0·98	57·0	1·3	56·54	1·0	...	...	0·5
	Average	715·6	...	1·09	57·1	1·4	56·6	1·5	...	...	0·5
New South Wales— F.A.Q., 1936, Bulk ...	1	800·6	799·0—802·0	1·07	64·6	1·4	63·20	1·94	...	...	1·4
	2	...	...	...	...	...	63·24	2·54	...	...	...
„ Bagged ...	1	807·2	806·5—808·5	0·64	65·2	0·8	63·81	1·41	...	...	1·4
	2	...	...	...	...	...	63·74	2·0	...	...	...
Victoria— F.A.Q., 1936	1	804·1	803·0—806·5	1·05	64·9	1·3	63·65	1·56	...	...	1·3
South Australia— F.A.Q., 1936	1	794·8	793·0—796·0	1·06	64·1	1·4	62·80	1·88	...	...	1·3
	2	...	...	...	...	...	62·86	1·76	...	...	...

TABLE II.

The effect of method of sampling and the type of wheat on the magnitude of the sampling error and a comparison of the results obtained with the Schopper one-litre and the Australian standard (one-pint) chondrometers.

Type of Wheat.	Schopper one-litre chondrometer.						Australian standard chondrometer, No. 186.				Difference in bushel weight estimation between Schopper and Australian standard chondrometers. (lb. per bushel.)
	Number of observations.	Mean Weight (gm. per litre.)	S.D. (± gm.)	Mean Weight from conversion tables. (lb. per bushel.)	S.D. (± oz.).	Range about the mean within which 20 out of 21 observations may be expected to fall. (± oz.)	Number of observations.	Mean Weight. (lb. per bushel.)	S.D. (± oz.).	Range about the mean within which 20 out of 21 observations may be expected to fall.	
Western Australian—		gm.	gm.	lbs.	oz.	oz.		lb.	oz.	oz.	lb.
Standard :											
Divider sample	16*	797·7	1·5	64·4	1·9	3·8	16*	63·38	2·2	4·4	+1·02
Range of observations		794·0—803·0						62·75—63·5			
Scoop sample	34	796·2	5·8	64·2	7·5	15·0	...	...	...	...	..
Range of observations		787·0—803·0									
Flow sample	40	797·1	4·3	64·3	5·5	11·0	40	63·11	6·7	13·4	+1·19
Range of observations		785·5—802·0						62·0—63·62			
Dockage free grain :											...
Flow sample	5*	804·9	1·1	65·0	1·4	2·8	...	...	...	...	...
Range of observations		803·5—807·5									
Light weight :											
Divider sample	16*	682·3	5·4	54·1	6·9	13·8	16*	53·62	7·2	14·4	+0·48
Range of observations		669·0—694·0						52·5—54·5			
Scoop sample	33	678·5	9·3	53·8	11·8	23·6	...	...	...	...	...
Range of observations		657·5—691·0									
Flow sample 1	33	679·2	12·0	53·8	15·2	30·4	33	53·96	14·0	28·0	—0·16
Range of observations		653·0—696·0						52·0 55·19			
Flow sample 2		...	...	...	...	...	74	53·47	9·8	19·6	...
Range of observations								52·0—54·0			
New South Wales—											
F.A.Q., 1936† :											
Bulk wheat	10	...	...	64·40	2·6	5·2	...	...	...	...	...
Range of observations				64·1—64·6							
Bagged wheat	10	...	...	64·69	3·6	7·2	...	...	...	...	...
Range of observations				64·2—65·0							

* Each sample was weighed three times.

† Weighings reported by the N.S.W. Chamber of Commerce.

"BLACK SPOT" OR "SCAB" OF APPLES.

A serious menace to the Western Australian Apple Industry.

Another Outbreak recorded at Manjimup.*

H. A. Jaques Pittman, B.A., B.Sc.Agr. (Hons.), Dip.Ed., Plant Pathologist.

HISTORY OF THE DISEASE IN WESTERN AUSTRALIA.

The disease known as "Black Spot" or "Scab," caused by the fungus *Venturia inaequalis* (Cooke) Winter, or alternatively, *Fusicladium dendriticum* (Wal.) Fcl., is well known to apple growers in probably all the apple-growing countries of the world, with the exception of Western Australia.

"Black Spot" or "Scab" of apples has been recorded from England, on the Continent of Europe wherever apples are grown, in North America, South Africa and New Zealand, and from Queensland, New South Wales, Victoria, South Australia and Tasmania.

In the Eastern States of Australia it has this season caused unusually serious losses, owing to the climatic conditions being particularly favourable to the parasite responsible.

In Western Australia the disease was unknown officially until the 4th April, 1930, when a small number of "Cleopatra" apples badly affected with the disease were brought to the Plant Pathology Laboratory by Mr. J. Ramage, of Paterson & Co., Perth, from Manjimup, this constituting the first unquestionable record of the disease in Western Australia (3). The fungus was in a very active condition, each of the lesions being covered with thousands of the very typical, greenish-brown spores of the *Fusicladium* stage. A visit to the district by the Director of Agriculture (Mr. G. L. Sutton), the Superintendent of Horticulture (Mr. G. W. Wickens), and the writer, on 8th April, revealed that the fruits on about a dozen Cleopatra trees, well inside the boundaries of a single 17-acre orchard composed mainly of apple trees, were seriously affected. Several smaller lesions were also found on a few "Granny Smith" fruits, and numerous, newly-formed, lesions were detected on the *leaves* of a large number of trees of various varieties in the vicinity of the badly-affected ones. No other orchards in the district were found to be affected, but on 29th April of the same year, a number of "Granny Smith" apples from an orchard at the Porongorups, about 100 miles away, were also received at Head Office, and found to be affected with the *Fusicladium* stage of the scab fungus. In both instances rigorous spraying and other measures were immediately enforced by this Department, in an attempt to wipe out the disease, eradication being successfully accomplished, in each case, by the end of the following growing season. As a matter of fact, no infected leaves or fruit were found after the winter of 1930 in the Manjimup orchard, and only two or three apples and a few leaves were found to be infected in the Porongorups property following the winter referred to.

Since the 1930-31 season, no infected apple leaves or fruits had been found, despite careful search by Departmental officers, in any orchard in Western Australia, until the 5th February, 1936, when a new outbreak was discovered on the property of an apple-grower at Manjimup, some five miles distant, as the crow flies, from the Manjimup property on which it occurred in 1930. This latest out-

*Since this article was set up in print a further outbreak of apple scab, caused by *Venturia inaequalis*, has been recorded on a 60-acre apple orchard at Mount Barker in this State. The outbreak in this case was almost entirely restricted to several rows of "Cleopatra" apple trees, the great majority of the trees in the orchard being quite free from any trace of infection.

break was discovered by the writer while on a visit to the district in connection with matters affecting the tobacco industry. The grower already referred to intimated to the writer that he had suspicions that the dreaded "black spot" had broken out in his apple orchard, which is situated adjacent to his tobacco plots. On investigation it was found that a number of "Yates" and "Cleopatra" apple trees

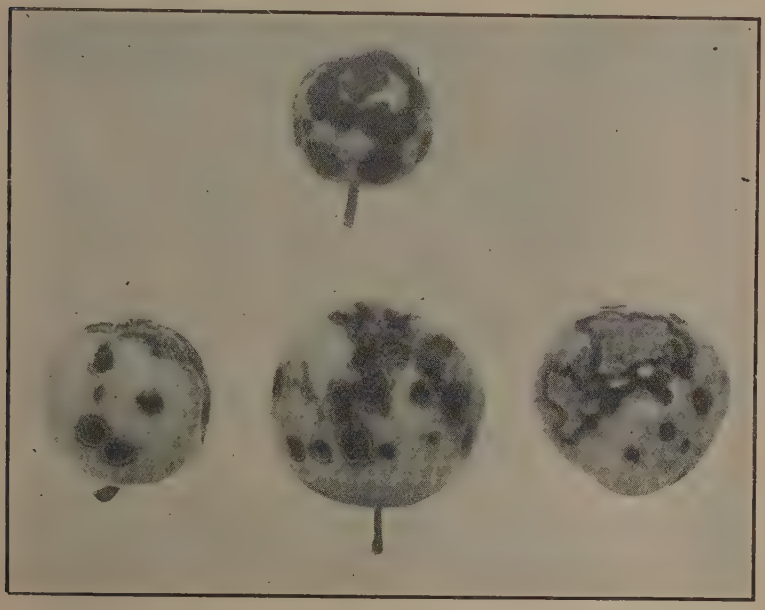

Fig. 1.—"Cleopatra" apples from a 17-acre apple orchard at Manjimup, W.A., which were submitted on 4th April, 1930, to the Department of Agriculture for report as to the disease present. The apples were found to be badly affected with the "Black Spot" or "Scab" disease caused by the fungus *Venturia inaequalis* (*Fusicladium dendriticum*) ; this being the first unquestionable record of the disease in Western Australia. On the 29th idem, several "Granny Smith" apples similarly affected were submitted from a small orchard at the Porongorups, about 100 miles, as the crow flies, from the first outbreak. In both instances rigorous spraying and other measures were immediately taken by the Department of Agriculture in an attempt to wipe out the disease. These were successful, no infected leaves or fruit being found during the following season on the larger orchard and only two or three apples and a few leaves being found affected during 1930-31 on the smaller orchard. Since that time, until 5th February, 1936, no infected leaves or fruit were found in any orchard in Western Australia. The eradication measures included repeated sprayings with Bordeaux mixture, immediate destruction of all diseased fruits, the use of a quick-growing cover crop during the autumn and winter to hold the fallen leaves *in situ*, and thorough ploughing and digging under of infected leaves in the early spring, before the breaking of the dormancy of the trees, followed by further Bordeaux sprayings until success was achieved.

It is worthy of note that the eradication of the original outbreaks of the disease was achieved without the destruction of a single tree being necessary.

[*Photo. by author.*]

near the centre of the orchard were fairly seriously affected with the disease, while several "Granny Smiths" and an odd "Winter Permain" were also very slightly affected. "Delicious" apples in the vicinity of the infected ones showed no signs of the disease. Altogether some forty or fifty trees distributed over an area of about one acre and a half, out of the whole area of 15 acres of apple trees, were found to be affected.

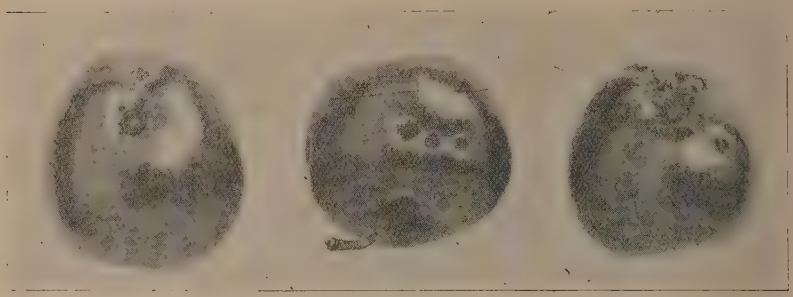

Fig. 2.—"Cleopatra" apples from Manjimup, February, 1936, badly affected with apple "scab" or "black spot," caused by the fungus *Venturia inaequalis* (*Fusicladium dendriticum*). Note the silvery margin of the three lesions on the centre apple, caused by the fungus rupturing and lifting up the apple skin (or *epidermis*). This is a very obvious characteristic of recently-formed, rapidly-growing lesions.

[*Photo. by Government Printer.*]

The infection appeared to have spread in two more or less fanshaped areas forming two diametrically opposite sectors of the same circle, and having a very badly diseased "Yates" tree at the common centre. The direction of spread was in the direction of the two prevailing winds which apparently blow, as a general rule, in the summer months, to the coast (towards the west) in the mornings, and from it (towards the east) in the afternoons.

A search of the neighbouring apple orchards revealed that the disease was not present in any other orchard visited, nor was it to be found, despite the most diligent searching, in the orchard of Mr. J. W. Brearley, Manjimup, on which it had been discovered in 1930, thus proving conclusively that the disease had been eradicated there.

METHODS USED IN ERADICATION OF PREVIOUS OUTBREAKS.

The methods laid down by the Department of Agriculture to eradicate the disease on this latter property, and used so successfully by Mr. Brearley in 1930-31, were as follows:—

All fallen fruit was immediately gathered up and boiled. All "Cleopatra" apples still on the trees were immediately picked and boiled. All reject fruit present in the packing shed or elsewhere was immediately destroyed by boiling. (The packing season was, of course, well advanced when the disease was discovered in April, so that most of the fruit of the early and midseason varieties had already been picked and sent from the orchard.)

All the apple trees in the orchard were forthwith sprayed, commencing at the outside rows, with home-made Bordeaux Mixture, 3-3-50 strength, plus spreader. No fruits other than the "Cleopatras" already mentioned were gathered until the spraying was completed.

After the fruit of various varieties still on the trees was gathered, as it became mature, the trees were sprayed with home-made Bordeaux Mixture, 6-6-50 strength, plus spreader. Spraying in all cases was done with a high pressure pump.

The whole of the area of the orchard was sown, before the end of April, with subterranean clover and an early variety of oats for a cover crop. This was ploughed under in a most efficient manner by Mr. Brearley, with a mouldboard plough, as soon as the land was fit after the third week in August. Seed for the cover crop was sown right up to the stems of the trees, and, at the time of ploughing under, any parts unploughable were dug under by hand.

In the spring of 1930 the following spraying schedule was used on all apple trees in the orchard:—

(a) Home-made Bordeaux Mixture, 6-5-50, plus spreader, at the "spur-bursting" stage;

(b) Home-made Bordeaux Mixture, 4-5-50, plus spreader, at the "pinking" stage of blossoming.

(c) Home-made Bordeaux Mixture, 2-5-50, plus spreader, at the "petal fall" stage.

A generally similar scheme was followed at the Porongorups.

The spreader used, in the spring, was 1 lb. calcium caseinate, or, in some cases, 1 lb. common flour to every 50 gallons of spray.

In the case of the autumn sprayings already referred to above, 2 lbs. good quality soft soap for every 50 gallons of spray was used with excellent results at the Porongorups, and slightly more than 1 lb. powdered skim milk ("Trufood") to every 50 gallons of spray at Manjimup, also with excellent results.

The above scheme of operations was planned by the Director of Agriculture (Mr. G. L. Sutton), the Superintendent of Horticulture (Mr. G. W. Wickens), and the writer, in consultation; and was put into operation, by the growers concerned, under the supervision of the Superintendent of Horticulture and Senior Horticultural Instructor, A. Flintoff, and the Superintendent of Horticulture and Horticultural Instructor, A. C. Vaughan, at Manjimup and the Porongorups, respectively.

ECONOMIC IMPORTANCE OF THE ERADICATION OF "BLACK SPOT" FROM THE APPLE ORCHARDS OF WESTERN AUSTRALIA.

Since the "Black Spot" or "Scab" disease of apples was discovered in Western Australia in the autumn of 1930, there have been five crops of apples grown and harvested in this State free from this disease, and the sixth disease-free crop is now in process of being harvested.

The total areas of bearing and non-productive apple trees in Western Australia during this period have averaged approximately 8,000 and 3,500 acres, respectively, per annum, as indicated by the figures compiled from official returns by the Government Statistician, Mr. S. Bennett, and set out in the various numbers of the "Statistical Register of Western Australia" covering the years referred to.

Experiments conducted by Miss Joan Hearman, under the direction of the writer, at Mt. Barker in 1932-33 on the closely related "Black Spot" or "Scab" disease of pears (see this Journal, pages 292-316, June, 1933), showed that the pear disease could be controlled at a minimum cost, for spray materials only, using Bordeaux Mixture, of 3.56 pence per tree. At 100 trees to the acre, and taking this same figure as a conservative estimate of the cost of the spray materials which would be required for an average-sized bearing apple tree, the saving to the apple growers of Western Australia, during every year that the "Black Spot" disease of apples is not existent in this State, is approximately £12,000 per annum for spray materials alone, even if the non-productive area is entirely excluded.

Allowing that the non-productive area would be largely composed of young apple trees not yet in bearing, it might be conservatively estimated that a further £1,500 would be required to cover the costs of spraying materials only, for this non-productive area.

The losses due to reduction and disfigurement of crop, and reduction in the general health of the trees, where the control measures were indifferently applied: the wastage due to the culling out of scabby fruit; the extra costs of picking over and packing; the labour costs for application of sprays and ploughing and digging under of special cover crops; the reduced value of the disease-free apples owing to possible spray blemish and russet, etc., might quite easily bring the total costs of contending with this disease in Western Australia up to £20,000 per annum, in the event of it becoming widespread throughout the apple orchards of the State—all this expenditure being involved without one extra penny piece accruing to the industry as the result of the expenditure.

The importance of any outbreak being immediately reported to the Department of Agriculture cannot, therefore, be over-emphasised; and the economic value to the industry of the work of the Department of Agriculture in ensuring the eradication of the two outbreaks in 1930, should be patent to all who may read the above five paragraphs.

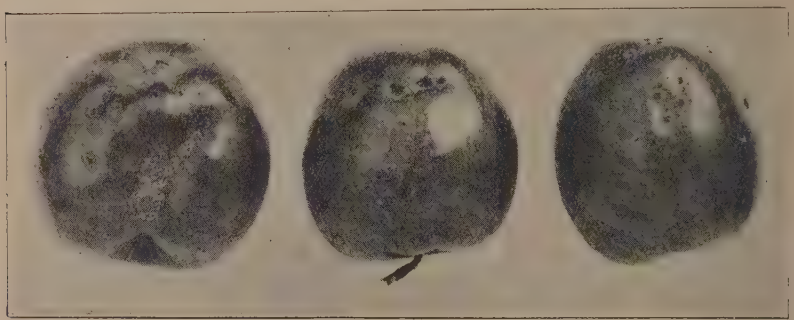

Fig. 3.—"Cleopatra" apples from Manjimup, February, 1936, affected with apple "scab" or "black spot." Note the very large lesion causing considerable distortion on the fruit on the left, and the very much smaller lesions elsewhere.

[*Photo. by Government Printer.*]

SOURCE OF ORIGIN OF THE OUTBREAKS IN WESTERN AUSTRALIA.

It is difficult to be sure of the manner in which the disease was introduced into Western Australia in 1930, or in the case of the present outbreak. In the present instance the disease apparently originated in a "Yates" apple tree growing adjacent to a group of young apple trees now in their second year, so that it is possible that the disease was introduced on an apple leaf still attached to one of the young trees or mixed up with the soil around the roots.

In view of the fact that the majority of the young apple trees for planting in Western Australian orchards have always been obtained from Victoria, in which State the disease has long been serious and widespread, it is rather surprising that the apple-growing industry of this State has for so long remained free of this disease, which is held by many authorities to be, perhaps, the most serious of all apple troubles.

In view of the comparative dryness of the summer conditions of the main apple-growing districts in Western Australia, the disease, should it become widespread, would probably never be as serious here as in, say, Victoria and Tasmania, where the summer humidity is, on the whole, much greater than in our main apple-growing districts. Nevertheless, as can be seen from the photographs herewith of affected apples from Manjimup, the disease, when uncontrolled, is capable of causing enormous havoc. It therefore behoves all growers to be constantly on the watch for the first sign of the trouble on their properties, and then immedi-

ately to communicate with this Department so that advice may be given as to the best methods of dealing with the situation, in the interests both of the grower concerned and his brother apple-growers throughout the State.

This article is written with the chief object of calling attention to the seriousness of the disease, the symptoms by which it may be recognised, the fact that the climatic conditions in this State are quite suitable for the disease (which some have questioned), and the control measures, by which, if they are conscientiously carried out, the disease, which is quite a controllable one, can be prevented from ever seriously detracting from the quality, or quantity, of the great bulk of Western Australia's apple crop.

As a matter of fact, preventive measures in the form of spraying, etc., would seem very well worth while in the case of orchardists situated at all close to the present place of outbreak.

DISTRIBUTION AND ECONOMIC IMPORTANCE OF APPLE "SCAB" OR "BLACK SPOT."

"Black spot" or "scab" of apples has now been recorded from all the States of the Commonwealth, and, as already indicated, it occurs also in England, on the Continent wherever apples are grown, in North America, South Africa, and New Zealand. Indeed its distribution seems to be almost as wide spread as apple culture, a fact which is not surprising, if the contention of certain writers, that it occurred on the wild parents of the apple, be true. Wherever it occurs it is much more serious in cool, moist climates than where the spring and summer climate is usually hot and dry, although even there it may do enormous damage in the occasional seasons favourable to its development.

Heald (2) states that in the United States of America the annual loss which it causes, even on the most conservative estimate, runs into millions of dollars, and that in Australia the average annual loss per acre has been estimated at nearly £10. In the State of Montana in U.S.A., in the years 1911 and 1912, the disease caused a loss of 15 per cent. of the crop.

These few figures will indicate that the disease is not to be lightly regarded. It is, indeed, by many authorities, considered the most serious apple trouble. Cunningham, for example, in referring to the economic importance of the disease in New Zealand, states that, "Black spot is the most serious apple disease with which the orchardist has to contend, as it not only weakens the tree by damaging the leaves, but reduces the market value of the fruit through the development of disfiguring spots, scabs, and cracks on the epidermis (skin) (1). In cases of severe infection the crop may become a total loss, owing to the developing fruits being so damaged as to fall to the ground at the time of setting or shortly after.

". . . Black spot thus affects the quantity as well as the quality of the output—the two factors on which the profit of the orchardist depends."

EFFECTS OF THE "APPLE SCAB" FUNGUS ON LEAVES, BLOSSOMS, FRUITS, AND SHOOTS.

(a) *Leaf Symptoms.*

Symptoms of "scab" upon the *leaves* may be of two distinct types. The more common type takes the form, when young, of more or less circular, greenish-brown, or greyish-green spots with a very much branched and tree-like structure, readily discernible under a lens, at the margins. Later in the season, the spots, under favourable conditions, may produce large numbers of spores, and in this condition they appear olive-green or almost black. As the spots become larger they often

blister up, and the dark, velvety surface then becomes smoother, duller, or sometimes shining and graphite-like in colour, as the spores are rubbed, washed, or blown away.

In the other type of leaf infection the fungus spreads in a very diffuse, or indefinitely-outlined, manner, over the tissue of the leaves, giving somewhat the impression of a kind of sooty mould, although the fungus is really below the cuticle and not above it as in the latter case. This type of lesion is most common on the bottom sides of the leaves, and tends to follow along the direction of the main veins.

Fig. 4.—"Black Spot" or "apple scab" lesions on apple leaf.
After Mason, "Spraying, Dusting and Fumigating of Plants."

Both these forms were seen by the author in the case of both outbreaks at Manjimup reported above. "When the scab spots are abundant or when the diffuse form is severe there may be more or less reduction in the size of the leaves with curling and distortion. In the severe diffuse type much leaf tisue is killed and the affected leaves or portions of them may appear as if scorched or burned . . . . The diseased areas may appear on either surface of the leaves, but the earliest infections are most frequently upon the lower surfaces"—(Heald, 1926) (2).

(b) *Fruit Symptoms.*

On the *fruits* the scab lesions first become obvious as small, brownish or black, irregular or circular spots without any break in the skin. With increase in the size of the lesions the *cuticle*, or transparent rubber-like coating over the first layer of cells, becomes ruptured, and the interior of the lesion then appears velvety and dark brown, or almost black, with an irregular and considerably frayed and torn, silvery-white, margin, which is the ruptured cuticle. This silvery-white and much lacerated cuticle can often be seen in the early stages with the naked eye, but it is, of course, much more readily distinguished with a hand lens. Under the lens the centres of newly-formed, smallish lesions, often have a mottled silvery-white and black appearance, due to the alternation of black patches of spores and pieces of ruptured cuticle. Many of the fruits infected in the early stages fall to the ground, but large numbers may persist on the trees. In such a case many of the infected apples will become badly distorted, owing to the more rapid rate of growth on the part of the healthy portions giving an unsymmetrical development. With increase in the size of the fruits and the lesions, the centre parts of the diseased areas often become bare, corky, and somewhat cracked or fissured, the edges of each lesion still, however, remaining infected and dark in colour, owing to the continual production of spores. It is this phase of the disease which has given rise to the common name "apple scab." Once the centre of a fruit lesion has become hard and corky, any further increase in the growth of the still healthy portions of the fruit may lead to the development of very large and unsightly cracks in the diseased area. When fully-grown, or almost fully-grown fruits are infected very late in the season, the lesions usually remain small, and the centres rarely become bare and corky. If apples recently infected with the scab fungus, or bearing *conidia* on their surfaces, are placed into cool or open storage, lesions may develop in the store.

Fig. 5.—"Black Spot" or "scab" on a "Cleopatra" apple from Manjimup, 1936. Note the bare corky area at the centre of the lesion and the black velvety band carrying living spores at the margin of the lesion.

[*Photo. by Government Printer.*]

(c) *Blossom Symptoms.*

In the case of *blossom* infection, lesions may appear on the flower-stalks (*pedicels*), petals, calyces, or young fruits. The lesions may be many and small, or of a diffuse and spreading nature. As a result of blossom infection there may be very considerable reduction in the amount of fruit set, besides great reduction in the quality of much that persists.

(d) *Twig Symptoms.*

"Scab" lesions on the *twigs* are stated to be confined to the bark of one-year old shoots (Heald, 1926) (2). "Young lesions on the twigs are very similar in appearance to those on the fruits, showing the central spore surface bordered by the uplifted epidermis (skin). Later in the season the spores may disappear and the bark show a more scaly character, due to the peeling of the bark in flakes . . . The twig lesions may be few and scattered, and thus may be easily overlooked, or they may be so numerous as to coalesce and produce more extended affected areas" (2). The lesions on the shoots may play a part in carrying the disease over from season to season, where the winter conditions are mild, as they may, under such conditions, produce a fresh crop of *conidia* in the following spring.

BLACK SPOT DISEASES OF APPLES AND PEARS CAUSED BY DIFFERENT PARASITES.

Any grower who is at all familiar with the "black spot" or "scab" disease of the pear, which for many years has been widespread in Western Australia, and which frequently causes tremendous havoc here, should have no difficulty in recognising the "black spot" disease of the apple the first time he sees it, as the lesions of the two diseases, especially on the *fruits* of apples and pears, are remarkably similar. The pear scab fungus, however, is a different species (*Venturia pirina*) to that which attacks the apple and neither fungus can attack the other host.

LIFE HISTORY OF THE FUNGUS AND CONTROL MEASURES.

A detailed account of the control measures which would have to be taken if this disease ever became widespread in Western Australia, and of the Life History of the fungus will be found in this Journal for June, 1930, pp. 241-263 (Vol. 7 (2nd series), No. 2), or in Bulletin No. 306, to which all readers requiring enlightenment on these points are referred.

The paragraph numbered "2" on page 14 of the Bulletin, or page 254 of the original article, should, however, in view of experience gained since it was written, be deleted, in favour of the following, as being preferable:—

"As soon as practicable in the autumn, sow down a cover crop such as oats, rye, barley, tick beans or New Zealand lupins or a mixture of oats and a legume, etc., so that the fallen leaves of the apple trees will become entangled therein and be prevented from blowing to still-uninfected parts of the orchard, or to other orchards still free from the disease. The cover crop should be planted after a light cultivation, if necessary, but without ploughing the soil, so that the surface of the soil will not be everted and the fallen apple leaves will remain unburied.

In the late winter or early spring, say about the end of August, and at least a fortnight before any signs of breaking of dormancy may be expected in the apple trees, plough the orchard deeply in one direction only, and as close up to the trees as possible, with a mould-board plough which will completely evert the sod and bury the fallen apple leaves deeply in the soil. Do not cross-plough at this time (unless the cross-ploughing be considerably shallower than the first).

Where the plough cannot reach, have the soil carefully dug over so as to put the original surface of the soil under-ground. The purpose of these operations is to bury the leaves (in which the fungus has been busy, during the winter, preparing fungal seeds to restart the disease in the spring) and put them where they will be unable to do any harm at the time of breaking of the dormancy of the trees.

The importance of this procedure in eradicating, or at least reducing, the black spot disease of the apple to a minimum cannot be overstated.

Subsequent cultivation of the soil should be delayed, as far as possible, until a month or so after the setting of the fruit, and all subsequent cultivations should be at a shallower depth than the original ploughing so as to avoid bringing the apple leaves up to the surface again until the following spring, when they will have completely disintegrated."

LITERATURE CITED.

(1) Cunningham, G. H.—"Fungous Diseases of Fruit Trees in New Zealand." The Brett Printing Co., Auckland, 1925.

(2) Heald, F. D.—"Manual of Plant Diseases." McGraw-Hill Co., New York, 1st. edit., 1926.

(3) Pittman, H. A.—" 'Black Spot' or 'Scab' of Apples and Pears in Western Australia," Journ. Dept. Agric., Western Australia, Vol. 7 (2nd series), pp. 241-263, June, 1930.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1934.

MERREDIN EXPERIMENT FARM.

I. Thomas, Superintendent of Wheat Farms,

and

J. Langfield, Farm Manager.

Despite the fact that 1,034 points of rain was registered during the year, of which 764 points fell in the growing period (May-October), the past season was the worst experienced at this farm since the drought year of 1914.

The chief features of the season were the long periods of dry weather at seeding time and again in September and early October, and the absence of any good soaking rains even in July and August when the monthly totals were relatively good.

The monthly rainfalls recorded at the farm, together with the averages for 24 years are given in the following table:—

					Growing Period.								
Year.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total.
1935	62	45	29	99	62	74	203	218	67	140	764	4	21	1,034
Average for 24 years ...	50	50	110	96	130	182	189	154	86	85	826	42	51	1,224

Falls totalling 86 points during the first four days of April gave promise of a satisfactory opening to the season, but unfortunately during the next 7½ weeks only 13 points were recorded. This afforded little or no opportunity for weed destruction before seeding and meant that the greater part of the crop was planted on a dry seed bed.

Sixty-two points fell between the 26th and 31st of May, causing patchy and uneven germination of the crops early in June. The June rainfall was the lowest recorded for years and was confined to the first half of the month, after which there was a dry spell of three weeks. At the beginning of July there appeared to be every prospect of a complete failure of the crops.

The position was greatly improved, however, by subsequent July and August rains totalling 421 points. The crops improved rapidly and by the end of August looked reasonably healthy though decidedly backward. No daily falls greater than 50 points had been registered, however, with the result that there was no reserve of soil moisture to meet the unfavourable conditions occasioned by the failure of the September rains. Between the 10th September and 18th October only 23 points were recorded, and this was spread over seven falls. The effect on the already backward crops was disastrous and although 140 points were recorded during the latter part of October, it was too late to be of much value.

The experiment, the nature of which entailed early planting, suffered most, the yields from the other experiments being in the circumstances, satisfactory, largely because the majority of them were not planted until after a cultivation following 54 points of rain at the end of May.

Except where the conditions of an experiment required otherwise, the land was ploughed to a depth of 3½in. in June, 1934, with a disc cultivating plough. Owing to weed growth, it was skim ploughed with the same implement in August. It was cultivated with a springtyne implement in October and disc cultivated again in November.

Following rains early in April, it was cultivated with a tandem disc implement.

The area of land on which the experiment was planted was, in appearance, an even piece of soil. There were, however, a number of large irregular "burnt-off" patches of crop. These patches would account for the large variations in plot weights that occur in some of the experiments.

The results of the field experiments are tabulated below.

To demonstrate the advantage of winter fallowing for the wheat crop.

TABLE 1.

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 6th June. Superphosphate—112 lbs. per acre. Germinated on 20th June.
Variety—Noongaar. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre. Section 1.	Section 2.	Section 3.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1925–35.	Percentage Yields, 1925–35.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Fallow	18 20	17 0	15 30	16 57	198	23 57	138
Non-fallow	6 20	9 20	10 0	8 33	100	17 24	100

As was the case in previous years when unfavourable growing conditions prevailed, notably 1925, 1928 and 1933, the response due to fallowing this year was again most marked, viz., 8 bushels 24 lbs. per acre or almost double the yield from the unfallowed plots. During the period the experiment has been conducted, there have been years when exceptionally good growing conditions prevailed and the fallowed plots have not shown to any advantage. The averaged results for the eleven years, however, show that the advantage due to fallowing is 6 bushels 33 lbs. or 38 per cent.

To determine the effect of early, midwinter and later winter fallowing on the wheat crop.

TABLE 2.

TIME FOR PLOUGHING EXPERIMENT.

Planted on 6th June. Superphosphate—112 lbs. per acre. Germinated on 20th June.
Variety—Noongaar. Seed—45 lbs. per acre.

Treatment.	Computed Yields per Acre. Section 1.	Section 2.	Section 3.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1930–35.	Percentage Yields, 1930–35.
	bus lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Ploughed mid-July ...	18 50	20 20	19 50	19 40	98	30 35	93
Ploughed mid-June ...	17 50	21 0	21 0	19 57	100	32 48	100
Ploughed-mid-August ...	20 10	19 50	15 50	18 37	93	25 8	77

The average results over the past six years show that higher yields are obtained when the land is fallowed early in the winter rather than in late winter or early spring.

To determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

TABLE 8.

MULCHING EXPERIMENT.

Planted on 5th June. Superphosphate—112lbs. per acre. Germinated on 15th June.
Variety—Noongaar. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1915-35.	Percentage Yields, 1915-35.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Mulched in spring, after rain during Summer, and before planting*	11 40	11 30	12 30	12 30	14 20	12 30	110	21 44	102
Mulched in Spring and before planting	10 0	10 10	10 40	11 30	14 20	11 20	100	21 16	100
Mulched before planting only ...	10 0	10 40	9 50	11 50	15 40	11 36	102	20 12	95

* Summer cultivations in February and April.

Last year's results showed that increased yields were obtained from the plots cultivated twice after rain during the summer months, while there was no significant difference between the neglected fallow plots and those cultivated in spring.

However, the average results over a period of eleven years indicate that a cultivation in spring is to advantage, but that yields are only slightly increased by summer workings.

To determine the most economical rate of seeding a midseason free-stooling variety.

TABLE 4.

RATE OF SEEDING EXPERIMENT.

Planted on 4th June. Superphosphate—112lbs. per acre. Germinated on 15th June.
Variety—Nabawa.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1913-35.*	Percentage Yields, 1913-35.*
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
30lbs.	12 0	14 20	14 50	15 30	18 30	15 2	75	19 38	94
45lbs.	16 50	20 10	19 20	20 20	23 40	20 4	100	20 55	100
60lbs.	20 10	21 10	20 0	21 40	22 30	21 6	105	21 4	101

* Excluding 1914 and 1931.

To determine the most economical rate of seeding an early sparse-stooling variety.

TABLE 5.

RATE OF SEEDING EXPERIMENT.

Planted on 6th June. Superphosphate—112lbs. per acre. Germinated on 16th June.
Variety—Noongaar.

Rate of Seed per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1913-35.*	Percentage Yields, 1913-35.*
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
30lbs.	17 10	15 40	16 0	14 40	15 20	15 46	82	18 58	95
45lbs.	20 0	17 20	20 30	18 10	19 40	19 8	100	19 55	100
60lbs.	25 0	21 50	24 20	22 0	21 40	22 58	120	19 54	100

* Excluding 1914.

The average results for both sections show that there is nothing to be gained by seeding at a rate greater than 45 lbs. per acre. The contrary results of last season were probably due to the heavier weed growth on the plots seeded at the lower rates.

To determine the most suitable month to plant a midseason maturing variety.

TABLE 6.

TIME OF PLANTING EXPERIMENT.

Superphosphate—112lbs. per acre. Variety—Nabawa. Seed—45lbs. per acre.

Planted.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929-35.	Percentage Yields, 1929-35.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
April 15th	16 40	14 20	13 10	12 10	13 30	13 58	102	23 37	107
May 15th	16 30	14 0	12 0	13 50	12 10	13 42	100	22 4	100
June 15th	9 20	8 40	5 10	6 30	5 50	7 6	52	17 46	80

To determine the most suitable month to plant an early maturing variety.

TABLE 7.

TIME OF PLANTING EXPERIMENT.

Superphosphate—112lbs. per acre. Variety—Gluyas Early. Seed—45lbs. per acre.

Planted.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1935.	Percentage Yields. 1935.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
June 15th	5 30	5 30	4 20	5 50	2 10	4 40	40	20 57	88
May 15th*	13 40	11 0	12 20	12 40	8 10	11 34	100	23 46	100
July 15th	6 0	4 10	4 40	3 40	1 10	3 56	34	13 22	56

The plots planted in the April and May sections did not germinate until early in June following upon the rains which fell during the last week in May. The germination in these and also the June section was irregular and it was not until the middle of July that germination was general throughout the experiment.

In only one of the past four seasons have the plots planted in April germinated immediately after sowing.

The results of this experiment, and particularly the results of the past year, show that the extension of the planting season into June results in lower yields being obtained.

To determine the most profitable amount of superphosphate to apply to the wheat crops.

TABLE 8.

RATE OF SUPERPHOSPHATE EXPERIMENT.

No. 1.

Planted on 5th June. Germinated on 15th July. Variety—Noongaar. Seed—45lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929-35.	Percentage Yields, 1929-35.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
225lbs.	12 40	14 40	12 20	12 50	15 50	13 40	108	25 19	104
150lbs.	11 40	12 0	12 40	11 30	15 40	12 42	100	24 15	100
300lbs.	12 0	13 10	14 40	11 30	15 30	13 22	105	25 38	106

TABLE 9.

RATE OF SUPERPHOSPHATE EXPERIMENT.

No. 2.

Planted on 5th June. Germinated on 15th July. Variety—Noongaar. Seed—45lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Percentage Yields, 1935.	Average Yields per acre, 1929-35.	Percentage Yields, 1929-35
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Nil	7 0	5 50	5 50	6 10	8 10	6 36	51	13 46	57
150lbs.	13 40	12 20	11 10	11 30	15 40	12 52	100	23 58	100
75lbs.	13 50	10 40	10 20	9 40	11 10	11 8	87	21 43	91

This year's results and the averages for the past seven years indicate that the rate of superphosphate can be increased with advantage above 75 lbs. per acre. The most economical rate on this class of soil under present conditions would be about 90-100 lb. per acre.

To determine the effect upon the wheat of—(a) a nitrogenous fertiliser, (b) a nitrogenous plus a potassic fertiliser.

TABLE 10.

POTASH-NITROGEN EXPERIMENT.

Planted on 6th June. Germinated on 16th June. Seed—45lbs. per acre.
Variety—Noongaar.

Treatment.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Per-centage Yields, 1935.	Average Yields per acre, 1932–35.	Per-centage Yields, 1932–35.
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Sulphate of Ammonia, 112lbs.; Superphosphate, 112lbs. per acre	18 0	20 50	18 20	19 0	19 20	19 6	102	25 52	102
Superphosphate, 112lbs. per acre	16 20	20 10	19 20	18 20	19 50	18 48	100	25 20	100
Sulphate of Ammonia, 112lbs.; Superphosphate, 112lbs.; Muriate of Potash, 56lbs.	18 50	18 30	20 40	17 50	20 40	19 18	103	25 30	101

The results both for last year and for the period 1932-35 show that the increased yield obtained when an application of superphosphate is supplemented with either a nitrogenous or a nitrogenous and potassic fertiliser is insufficient to cover the cost of these special fertilisers.

(a) To ascertain the most suitable months to plant a midseason, early and very early maturing variety of wheat. (b) To determine the most prolific of these crops.

TABLE 11.

APRIL SEASONAL PLANTING EXPERIMENT.

Planted on 15th April. Superphosphate—112 lbs. per acre. Germinated on 10th June.
Seed—45lbs. per acre

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Per-centage Yields, 1935.	Per-centage Yields 1929–35.
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Bencubbin ...	Midseason	11 40	12 40	15 30	11 20	13 30	12 56	90	112
Nabawa	Midseason	12 30	14 30	16 10	14 10	14 10	14 18	100	100
M 38	Midseason	9 0	12 30	12 30	12 0	13 0	11 48	83	*95

* 1934–35.

TABLE 12.

MAY SEASONAL PLANTING EXPERIMENT.

Planted on 15th May. Superphosphate—112lbs. per acre. Germinated on 10th June.
Seed—45lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre. Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.	Average Yields per acre, 1935.	Per-centage Yields, 1935.	Per-centage Yields 1928–35.
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Bencubbin ...	Midseason	2 50	16 30	6 0	11 0	6 50	8 38	89	111*
Nabawa	Midseason	5 0	15 0	8 10	10 20	10 0	9 42	100	100
M 38	Midseason	3 10	11 10	7 30	7 50	10 40	8 4	83	95†
Gluyas Early ...	Early ...	8 50	14 10	12 20	12 0	13 20	12 8	110	109
Nabawa	Midseason	10 0	11 50	10 20	9 50	13 20	11 4	100	100
Totadgin ...	Early ...	13 40	13 0	13 40	12 50	15 40	13 46	124	118‡
Geeralying ...	Very Early	13 30	11 0	13 30	12 10	13 50	12 48	109	97
Nabawa	Midseason	13 0	10 40	12 0	10 30	12 50	11 48	100	100
Merredin	Early ...	14 20	13 0	11 40	10 0	13 40	12 32	106	108
M 36	Midseason	7 10	8 50	6 0	2 40	7 40	6 28	57	58§
Nabawa	Midseason	13 20	13 10	13 40	7 40	8 30	11 16	100	100
Carrabin	Early ...	10 20	12 10	13 0	8 10	12 20	11 12	99	94
S.H.J.	Early ...	11 30	10 40	12 40	7 50	11 40	10 52	96	89
Nabawa	Midseason	15 10	8 30	16 0	7 0	10 10	11 22	100	100
Noongaar	Very Early	15 0	12 0	14 50	11 50	12 50	13 18	117	102

* 1929–35. † 1934–35. ‡ 1931–35. § 1935.

TABLE 13.

JUNE SEASONAL PLANTING EXPERIMENT.

Planted on 15th June.		Superphosphate—112lb. per acre. Seed—45lb. per acre.					Germinated on 15th July.		
		Computed Yields per Acre.					Average Yields per acre. 1935.	Percentage Yields, 1935.	Percentage Yields per acre, 1928–35.
Variety.	Maturity.	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Bencubbin ...	Midseason	6 40	9 30	20 0	14 20	15 40	13 14	112	113*
Nabawa	Midseason	6 40	9 0	17 30	12 0	14 10	11 52	100	100
M 38	Midseason	5 40	8 30	15 0	10 40	11 20	10 14	86	94†
Gluyas Early ...	Early ...	13 50	15 50	17 10	13 20	15 40	15 10	109	110
Nabawa	Midseason	8 50	16 50	16 10	13 30	14 20	13 56	100	100
Totadgin ...	Early ...	11 40	16 40	16 30	17 10	19 0	16 12	116	117‡
Geeralying ...	Very Early	8 40	9 50	13 0	13 20	15 0	11 58	103	99
Nabawa	Midseason	6 50	13 40	12 30	10 40	14 40	11 40	100	100
Merredin ...	Early ...	4 40	16 30	9 0	6 30	7 50	8 54	76	106
M 36	Midseason	2 50	13 0	5 10	4 20	3 50	5 50	63	63§
Nabawa	Midseason	5 0	18 0	9 0	6 40	7 30	9 14	100	100
Carrabin	Early ...	8 50	18 20	11 10	6 0	7 40	10 24	111	97
S.H.J.	Early ...	12 10	17 10	13 30	7 20	6 20	11 18	81	88
Nabawa	Midseason	16 50	20 30	15 30	11 50	5 30	14 2	100	100
Noongaar	Very Early	19 40	23 0	17 40	17 0	14 40	18 24	131	116

* 1930–35. † 1934–35. ‡ 1931–35. § 1935 only.

The April and May sections germinated at the same time, early in June following rain late in May. The germination of the plots in the June section was patchy and uneven until the middle of July.

In the May section the early maturing variety "Totadgin" was outstanding, being 14 per cent. better than "Gluyas Early," whilst in the June section it also showed to advantage but did not equal the early maturing variety "Noongaar," which was 15 per cent. better.

The average results are similar except that "Totadgin" is equal to "Noongaar" in the June section.

With regard to the midseason varities, "Bencubbin" did not equal the control variety "Nabawa" in the April and May sections, but it gave better results in the section planted in June. In the percentage average results for a period of years it has shown to advantage in all three sections.

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ROYAL AND DISTRICT AGRICULTURAL SOCIETIES' 50-ACRE CROP COMPETITIONS, 1935.

I. Thomas, Superintendent of Wheat Farms.

Entry for these competitions is made through the local Agricultural Societies. These societies organise their own district competitions, the first and second prize winners of which automatically become eligible to compete for the Royal Agricultural Society zone prize. Where the local society does not conduct a com-

Map showing boundaries of the respective zones.

petition, entry is accepted direct with the parent body, the Royal Agricultural Society. In this way no farmer, desirous of doing so, is prevented from participating.

This year entries were received from 16 district agricultural societies and three entries were made direct with the Royal Agricultural Society, making a total of 97 competitors.

The following table shows the number of competitors and the average yields obtained each year since the competition was inaugurated:—

Year.	Number of District Agricultural Societies competing.	Number of Competitors.	Average Yeld of Competitors. bush.	Average Yield for State. bush.
1921	...	15	25	10·4
1922	...	32	24	8·9
1923	12	82	29	11·4
1924	15	70	31	12·8
1925	13	59	22·5	9·7
1926	11	99	24·5	12·0
1927	10	100	26·9	12·1
1928	13	114	22·5	10·1
1929	12	156	21·7	11·0
1930	15	165	27·4	13·3
1931	13	110	27·4	13·1
1932	17	168	29·3	12·3
1933	17	130	27·2	11·7
1934	17	114	26·8	...
1935	16	97	24·8	8·3*

* Estimate. District Agricultural Societies did not compete until 1923.

The special prize of £5 5s. for the competitor obtaining the highest calculated yield per acre was awarded this year to E. Davis of Kebaringup, who obtained a yield of 41 bushels per acre with the variety "Bencubbin."

The winners of this prize since its inception, are as follow:—

	Bus./Acre.
1925—Hebiton & Sons, Three Springs, "Nabawa" ..	34
1926—Cuming Bros., Carnamah, "Yandilla King" ..	38
1927—A. W. Parkinson, Gnowangerup, "Yandilla King"	40
1928—A. W. Parkinson, Gnowangerup, "Yandilla King"	40
1929—C. E. Cockram, Pallinup, "Yandilla King" ..	46
1930—C. Smith & Sons, Yarding, "Gluclub"	43
1931—H. O. Beeck, Gnowangerup, "Yandilla King" ..	42
1932—F. S. Freebairn, Jilakin, "Gluclub"	47
1933—D. Davis, Gnowangerup, "Bencubbin"	43
1934—C. E. Cockram, Pallinup, "Free Gallipoli" ..	40
1935—E. Davis, Gnowangerup, "Bencubbin"	41

The seasonal condition, under which the crops were grown this year, was not a favourable one. During the month of January the climatic conditions were dry and hot, but in the following month general rains occurred which were of value in replenishing water supplies.

Tropical depressions on the N.W. coast in March were responsible for rains over the Northern section of the wheat belt; elsewhere dry conditions prevailed.

With the exception of the eastern districts, where falls were well below the average, good general wheat belt rains occurred in early April. In many districts these rains were sufficiently heavy to fill dams and germinate weed seeds and pastures. Unfortunately, a long dry spell then intervened before the commencement of the true winter type rains at the end of May and early in June. The rainfall for June, however, was well below the average over the whole of the wheat belt and particularly so over the north-eastern and eastern districts where seasonal prospects were now decidedly poor.

It was not until July that general soaking rains fell and considerably improved the outlook throughout. As a result of satisfactory August rains, the position was further improved and it appeared as though the bad start might be offset by favourable growing conditions in the latter part of the season.

On account of most of the crops having been planted in a comparatively dry seed bed, considerable trouble was experienced with weed growth. The more optimistic outlook for these backward crops, which had been induced by the satisfactory July and August rains gave place to concern when the September rains failed. This was particularly the case in the north-east districts which were, by then, in a precarious position. Conditions along the east of the Great Southern Railway were greatly improved by generous falls in October and in this area the crops were enabled to mature normally.

These good October rains extended in a northerly direction as far as Tammin, Kununoppin and Mukinbudin and east as far as Southern Cross. The unusually long dry spell which had prevailed in these areas for approximately six to seven weeks prior to these rains, had caused the crops to ripen prematurely and they, therefore, were too far advanced to derive full benefit from this available moisture.

In the remainder of the wheat belt, falls for October were decidedly below the average and yields were, therefore, disappointing, especially so in the north-eastern areas.

The detailed awards made by the judges in the different zones are as follow:—

ZONE 1.

Judge—G. L. Throssell, Agricultural Adviser.

Competitors—Carnamah Society, 6.

The rainfalls recorded at Carnamah and Coorow for the year are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Carnamah ...	107	41	88	191	80	182	223	318	79	7	889	6	8	1,240
Coorow ...	70	17	28	124	64	153	171	291	92	18	789	4	5	1,037

Carnamah Agricultural Society.

The following table shows the awards made to the respective competitors from the above society which were the only entries made in this Zone:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Forrester, J. K. ...	Carnamah ...	Nabawa ...	25	9	9	14	13	70
Niven, R. ...	do. ...	Gluyas Early ...	23	9	8	14	14	68
Read, J. ...	Coorow ...	Merredin ...	25	7	8	14	13	67
Humphries, J. B.	Carnamah ...	Ford	22	9	8	13	14	66
Clark, R. W. ...	do. ...	Merredin ...	23	7	8	14	12	64
Bothe, B. D. ...	Coorow ...	Sutton ...	22	8	7	14	13	64

ZONE 2.

Judge—G. L. Throssell, Agricultural Adviser.

Competitors—Perenjori Society, 6.

The rainfalls recorded at Perenjori, Latham and Bowgada for 1935 are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year
Perenjori ...	94	97	189	190	62	58	219	226	57	10	632	...	8	1,210
Latham ...	88	79	91	224	68	111	263	244	76	16	778	...	2	1,262
Bowgada ...	160	90	398	128	34	77	230	214	64	...	619	...	12	1,407

Perenjori Agricultural Society.

The following table shows the awards obtained by the respective competitors of the above society which were the only entries made in this Zone:—

Competitor.	ddress.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Carstairs, J. ...	Perenjori ...	Gluclub ...	26	9	9	12	12	68
McAlpine, W. A.	Latham ...	Bencubbin ...	24	9	8	14	12	67
Davis, F. J. ...	Bowgada ...	Merredin ...	22	9	9	13	12	65
Baxter, E. ...	Perenjori ...	do. ...	18	9	8	14	11	60
Monk, E. ...	Latham ...	Bencubbin ...	17	8	8	13	10	56
Young, W. C. ...	Bowgada ...	Merredin ...	17	8	7	12	11	55

ZONE 3.

Judge—R. P. Roberts, Agricultural Adviser.

Competitors—Wyalkatchem Society, 3; Royal Society, 2; total, 5.

The rainfalls recorded in the various competing districts in this Zone are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Wyalkatchem	84	216	17	78	42	55	209	179	97	17	599	...	5	999
Korrelocking ...	80	273	14	90	68	79	222	194	105	31	639	...	10	1,106
Cowcowing ...	50	240	10	88	107	56	164	198	63	13	601	...	8	997
Goomalling ...	75	110	17	85	64	144	219	223	74	47	771	3	4	1,065
Minnivale ...	93	209	30	106	60	70	263	209	109	27	738	...	10	1,246

Royal Agricultural Society and Wyalkatchem Agricultural Society.

There were three competitors only from the Wyalkatchem Society and the points awarded to these, together with those obtained by the remaining two competitors in the Zone who entered direct with the Royal Agricultural Society are detailed in the combined table below:—

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Jones, W. W. ...	Cowcowing ...	Wyalkatchem	Bencubbin	22	7	9	14	13	65
Waterhouse, E. J.	Goomalling ...	Royal ...	Bencubbin	24	7	8	13	11	63
Hughes, J. R. ...	Minnivale ...	Royal ...	Nabawa ...	20	9	9	12	12	62
Tyler, J. E. ...	Korrelocking	Wyalkatchem	Gluclub ...	20	8	8	12	13	61
Threlfall, H. ...	Wyalkatchem	Wyalkatchem	Totadgin ..	18	8	9	12	12	59

ZONE 4.

Judge—F. L. Shier, Senior Agricultural Adviser.

Competitors—Kulja Society, 2; Mt. Marshall Society, 4; Nungarin Society, 4; Total, 10.

The following are the monthly rainfall registrations of the various competing districts in this Zone:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Kulja	37	120	10	75	19	52	189	211	56	17	544	...	4	790
Karloning ...	85	88	35	...	59	12	207	193	55	48	574	...	13	795
Jouerdine ...	69	149	28	57	18	19	174	210	60	56	537	...	34	874
Bencubbin ...	50	66	41	47	30	35	168	263	67	18	581	...	10	795
Nungarin ...	40	51	8	119	76	53	229	183	47	122	710	...	26	954
Nukarni ...	38	55	6	79	104	47	206	235	62	169	823	2	69	1,072

Kulja Agricultural Society.

The following table shows the points awarded to each competitor:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Stehn, N. D. ...	Kulja	Bencubbin ...	15	8	9	14	13	59
Crain, H. T. ...	do.	Gluyas Early ...	13	7	8	13	13	54

Mt. Marshall Agricultural Society.

The awards made for the competition held by this society are as follow:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Hopwood, B. W. G.	Bencubbin ...	Bencubbin ...	16	9	9	14	13	61
Wright, W. H. ...	do. ...	do. ...	12	8	9	14	13	56
Collins, D. W. ...	do. ...	do. ...	10	9	9	14	13	55
Gilham, — ...	do. ...	do. ...	8	9	9	14	13	53

Nungarin Agricultural Society.

The following table shows the points awarded to the respective competitors:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Creagh Bros. ...	Nungarin ...	Noongaar ...	17	8	9	14	14	62
Evans, L. D. ...	Nukarni ...	Totadgin ...	14	8	9	14	13	58
Watson Bros. ...	Nungarin ...	Bencubbin ...	14	8	8	14	13	57
Kittyer, J. ...	Nukarni ...	Totadgin ...	13	7	9	14	12	55

ZONE 5.

Judge—J. H. Langfield, Merredin Experiment Farm.

Competitors—Merredin Society, 6; Bruce Rock Society, 2; Total, 8.

The rainfalls recorded at the various competing centres in this Zone are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Merredin ...	53	40	41	83	64	84	265	259	91	135	898	8	24	1,147
Ulva	52	67	28	70	63	122	281	191	59	175	891	...	6	1,114
Belka	38	81	31	186	49	95	293	276	105	174	992	3	19	1,350
Jilbadji ...	37	48	56	45	56	86	299	308	125	320	1,194	...	65	1,445
Bruce Rock ...	58	33	34	104	39	95	212	182	64	192	784	...	11	1,024
Yarding ...	69	88	24	80	45	135	232	160	46	222	840	3	...	1,084

Merredin Agricultural Society.

The points awarded each competitor are shown in the following table:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Teasdale, H. W.	Ulva	Totadgin ...	27	8	9	14	13	71
Harling, H. H. ...	Belka	do. ...	24	9	9	14	13	69
Flockart, I. ...	Merredin ...	Bencubbin ...	24	8	9	14	12	67
Smallacombe, T. H.	do. ...	Totadgin ...	21	8	9	14	14	66
Clothier, J. E. ...	do. ...	Bencubbin ...	21	7	9	14	12	63
Crouch, W. S. ...	Jilbadji ...	Totadgin ...	19	6	8	14	12	59

Bruce Rock Agricultural Society.

There were only two entries with this society, the points awarded being shown in the table below:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Smith & Sons ...	Yarding ...	Gluclub ...	26	8	9	14	12	69
Buller, A. M. ...	Bruce Rock ...	do. ...	22	8	8	14	13	65

ZONE 7.

Judge—A. S. Wild, Senior Agricultural Adviser.

Competitors—Kukerin Society, 8; Lake Grace Society, 10; Harrismith Society, 5; Karlgarin Society, 11; Kulin Society, 10; Total, 44.

Kukerin Agricultural Society.

The rainfalls recorded in the vicinity of the competing areas are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Kukerin ...	29	61	38	91	104	215	425	269	201	180	1,394	...	22	1,635
Moulyinning ...	25	41	25	106	58	200	450	230	142	151	1,240	...	22	1,450

The awards made are as follow:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Faulkner, W. J. ...	North Kukerin	Bencubbin ...	37	9	9	14	13	82
Pike, G.	Kukerin ...	Bald Early ...	32	9	8	13	13	75
Gard, T. ...	South Kukerin	Gluclub ...	27	9	9	14	13	72
Troup, A. ...	Kukerin ...	Bencubbin ...	27	9	9	13	13	71
Fitton, J. ...	North Moulyinning	do ...	29	7	8	14	12	70
Williams, T. C. ...	South Kukerin	do ...	26	9	9	13	13	70
Joyce, F ...	North Kukerin	do. ...	28	7	8	12	12	67
English, T. C. ...	South Kukerin	do. ...	25	7	8	14	11	65

Lake Grace Agricultural Society.

The rainfall recorded at Lake Grace is as follows:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Lake Grace ...	82	10	44	75	130	170	275	219	155	307	1,256	...	31	1,498

The points awarded the individual competitors are shown hereunder:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Darby, A. H. ...	Lake Grace ...	Bencubbin ...	36	9	8	14	14	81
Bennett, E. ...	do. ...	Totadgin ...	30	9	8	14	13	74
Carruthers, W. ...	do. ...	Bencubbin ...	29	8	9	14	13	73
Fry, E.	North Lake Grace	Gluclub ...	32	8	7	13	13	73
Pieper, H. ...	Lake Grace ...	Bencubbin ...	28	9	9	13	13	72
Coad, H. J. ...	do. ...	Totadgin ...	25	9	8	14	13	69
Carruthers, J. ...	do. ...	Bencubbin ...	25	9	9	13	12	68
Lay, J.	do. ...	do. ...	27	7	7	13	12	66
Carruthers, H. F.	do. ...	do. ...	26	7	8	11	13	65
Kay, W. H. & F. C.	do. ...	Gluyas Early ...	24	8	6	13	12	63

Karlgarin Agricultural Society.

The rainfalls recorded at the several centres represented by competing areas are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Karlgarin ...	48	22	70	229	73	105	225	188	104	239	934	...	15	1,318
North Hyden ...	46	51	50	116	66	104	346	193	122	250	1,081	8	28	1,380
Graham Rock	44	35	49	80	61	87	293	211	151	348	1,151	2	22	1,383
Kondinin ...	86	43	66	125	163	107	265	191	107	267	1,101	3	23	1,447

The awards made are shown in the accompanying table:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100pts.
Grant, L. J. ...	Karlgarin ...	Bencubbin ...	29	9	8	13	13	72
Green & Atkinson	North Hyden...	do. ...	24	9	8	14	14	69
Medcalf, C. W. ...	Karlgarin ...	do. ...	26	8	8	13	13	68
Ray, H. A. ...	do. ...	do. ...	27	8	8	12	13	68
Trestrail, S. J. ...	do. ...	Totadgin ...	25	9	8	13	13	68
Biglin, D. ...	do. ...	Gluyas Early ...	23	9	8	13	13	66
James, S. W. ...	do. ...	Bencubbin ...	21	8	9	13	13	64
Brooks, J. ...	Graham Rock...	Gluyas Early ...	23	9	6	12	13	63
Clayton Bros. ...	North Hyden ...	Totadgin ...	18	9	8	14	14	63
Biglin, E. J. ...	Karlgarin ...	do. ...	19	7	8	14	12	60
Smith, W. G. ...	Kondinin ...	Merredin ...	20	7	7	13	12	59

Harrismith Agricultural Society.

The rainfalls recorded at Harrismith are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept	Oct.	Total.	Nov.	Dec.	Total for Year.
Harrismith ...	41	74	25	65	140	205	380	229	134	187	1,275	4	26	1,510

The points awarded are given in the table below:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Ballard, B. ...	Tinkurrin ...	Bencubbin ...	31	9	9	12	13	74
McDonald, J. M.	do. ...	do. ...	27	9	9	13	13	71
Murray, A. ...	do. ...	Canberra ...	23	9	7	14	13	66
Norton, J. M. ...	do. ...	Bencubbin ...	23	8	8	13	13	65
Dare, F. R. ...	Harrismith ...	Nabawa ...	20	8	9	11	12	60

Kulin Agricultural Society.

The rainfalls recorded at the various competing centres are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Kulin	101	51	55	74	133	155	354	224	136	155	1,157	...	7	1,445
Kulin Rock ...	196	11	51	63	127	151	257	227	111	148	1,021	5	4	1,351
Jilakin ...	109	53	42	70	135	156	240	210	119	134	994	1	9	1,278

The awards made are shown below:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Scadding, N. A. ...	Jilakin ...	Bencubbin ...	34	9	9	12	14	78
Trotter, A. W. ...	Kulin	Rajah ...	35	8	8	12	13	76
Russell, H. ...	Kulin Rock ...	Ford	32	9	8	12	14	75
Christenson, J. C.	Jilakin ...	Bencubbin ...	30	9	9	12	14	74
Bele, J. H. ...	Kulin Rock ...	Gluclub ...	30	8	8	13	13	72
Hodgson, H. J. ...	Jilakin ...	do. ...	29	9	7	12	14	71
Onesti, L. ...	do. ...	do. ...	28	9	7	12	13	69
Freebairn, F. S. ...	Kulin Rock ...	do. ...	27	9	7	12	13	68
Bowey, P. J. ...	Kulin	Sword	26	8	7	12	13	66
Doncon, E. R. ...	East Wickepin	Canberra ...	26	7	7	12	14	66

ZONE 8.

Judge—N. Davenport, Senior Agricultural Adviser.

Competitors—Wickepin Society, 4; Gnowangerup Society, 10; Royal Society, 1; Total, 15.

The rainfalls recorded by the competing districts in the Zone are as follow:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Wickepin ...	42	131	16	70	102	163	324	218	116	208	1,131	1	1	1,392
Gnowangerup...	51	48	...	89	87	176	306	202	149	132	1,052	...	27	1,267
Kebaringup ...	48	45	6	113	96	180	281	210	115	144	1,026	2	30	1,270
Borden ...	33	54	...	82	68	162	241	197	161	172	1,001	...	38	1,208

Wickepin Agricultural Society.

The points awarded the several competitors are shown below:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Fleay & Sons ...	Wickepin ...	Totadgin ...	32	8	9	13	13	75
Doncon, E. ...	do. ...	Bencubbin ...	30	9	8	14	13	74
Hoskens Bros. ...	do. ...	Totadgin ...	28	9	9	14	13	73
Miller, G. ...	do. ...	Bencubbin ...	25	9	9	14	14	71

Gnowangerup Agricultural Society.

The awards made are shown in the table hereunder:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Davis, E. ...	Kebaringup ...	Bencubbin ...	41	9	9	14	14	87
McDonald, J. ...	Gnowangerup...	do. ...	34	9	8	14	14	79
White, R. H. ...	Pallinup ...	do. ...	31	9	9	14	13	76
Cockram, C. ...	do. ...	Free Gallipoli...	28	9	9	14	14	74
Dolley, S. ...	Jackitup ...	Yandilla King	32	7	9	14	12	74
Murray, W. D. ...	Gnowangerup...	do.	29	9	8	14	13	73
Murray, W. W. ...	South Borden...	Bencubbin ...	30	7	8	14	13	72
Stewart, W. B. ...	do. ...	do. ...	30	6	9	14	13	72
Taylor, C. ...	Pallinup ...	Waratah ...	28	8	8	14	13	71
Wellard & Wellard	Gnowangerup...	Free Gallipoli...	25	9	7	13	12	66

Royal Agricultural Society.

The only entry made direct with the Royal Agricultural Society was at South Caroling, the rainfall for which is as follows:—

Station.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
S. Caroling ...	79	72	41	52	177	168	264	195	62	279	1,145	*Nil*	12	1,401

The points awarded are as under:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Richards, A. ...	South Caroling	Gluclub ...	33	9	9	14	13	78

ZONE 9.

Judge—A. S. Wild, Senior Agricultural Adviser.

Competitors—Phillips River Society, 3.

Phillips River Agricultural Society.

The rainfalls recorded at Ravensthorpe and Mt. Short are as follow:—

Station	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Ravensthorpe...	79	29	44	51	65	84	177	233	134	196	889	14	56	1,162
Mt. Short ...	92	37	33	54	70	103	158	191	171	227	920	9	51	1,196

The points awarded the three competitors in this competition, which are the only entries for the Zone, are as set out below:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Campbell, J. ...	Mt. Short ...	Bencubbin ...	28	9	8	13	12	70
Barrett, M. ...	Ravensthorpe...	do. ...	26	9	8	13	13	69
Bebbington Bros.	Mt. Short	Totadgin ...	23	9	9	13	12	66

ROYAL AGRICULTURAL SOCIETY ZONE CHAMPIONSHIP AWARDS.

Representatives from District Agricultural Societies' Competitions and entries received direct by the Royal Agricultural Society.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
ZONE 1.—Judge: G. L. Throssell, Agricultural Adviser.									
Forrester, J. K.	Carnamah ...	Carnamah ...	Nabawa ...	25	9	9	14	13	70
Niven, R. ...	do. ...	do. ...	Gluyas Early	23	9	8	14	14	68
ZONE 2.—Judge: G. L. Throssell, Agricultural Adviser.									
Carstairs, J. ...	Perenjori ...	Perenjori ...	Gluclub	26	9	9	12	12	68
McAlpine, W. A.	Latham ...	do. ...	Bencubbin	24	9	8	14	12	67
ZONE 3.—Judge: R. P. Roberts, Agricultural Adviser.									
Jones, W. W. ...	Cowcowing...	Wyalkatchem	Bencubbin	22	7	9	14	13	65
Waterhouse, E. J.	Goomalling ...	Royal ...	do. ...	24	7	8	13	11	63
Hughes, J.R. ...	Minnivale ...	do. ...	Nabawa ...	20	9	9	12	12	62
Tyler, J. E. ...	Korrelocking	Wyalkatchem	Gluclub ...	20	8	8	12	13	61
ZONE 4.—Judge: F. L. Shier, Senior Agricultural Adviser.									
Creagh Bros. ...	Nungarin ...	Nungarin ...	Noongaar	17	8	9	14	14	62
Hopwood, B. W. G.	Bencubbin ...	Mt. Marshall	Bencubbin	16	9	9	14	13	61
Stehn, N. D. ...	Kulja ...	Kulja ...	do. ...	15	8	9	14	13	59
Evans, L. D. ...	Nukarni ...	Nungarin ...	Totadgin	14	8	9	14	13	58
Wright, W. H.	Bencubbin ...	Mt. Marshall	Bencubbin	12	8	9	14	13	56
Crain, H. T. ...	Kulja ...	Kulja ...	Gluyas Early	13	7	8	13	13	54
ZONE 5.—Judge: J. H. Langfield, Manager, Merredin Experiment Farm.									
Teasdale, H. W.	Ulva ...	Merredin ...	Totadgin...	27	8	9	14	13	71
Harling, H. H. ...	Belka ...	do. ...	do. ...	24	9	9	14	13	69
Smith & Sons ...	Yarding ...	Bruce Rock	Gluclub ...	26	8	9	14	12	69
Buller, A. M. ...	Bruce Rock	do. ...	do. ...	22	8	8	14	13	65
ZONE 7.—Judge: A. S. Wild, Senior Agricultural Adviser.									
Faulkner, W. J.	North Kukerin	Kukerin ...	Bencubbin	37	9	9	14	13	82
Darby, A. H. ...	Lake Grace...	Lake Grace...	do. ...	36	9	8	14	14	81
Scadding, N. A.	Jilakin ...	Kulin ...	do. ...	34	9	9	12	14	78
Trotter, A. W. ...	Kulin ...	do. ...	Rajah ...	35	8	8	12	13	76
Pike, G. ...	Kukerin ...	Kukerin ...	Bald Early	32	9	8	13	13	75
Ballard, B. ...	Tinkurrin ...	Harrismith ...	Bencubbin	31	9	9	12	13	74
Bennett, E. ...	Lake Grace...	Lake Grace...	Totadgin	30	9	8	14	13	74
Grant, L. J. ...	Karlgarin ...	Karlgarin ...	Bencubbin	29	9	8	13	13	72
McDonald, J. M.	Tinkurrin ...	Harrismith ...	do. ...	27	9	9	13	13	71
Green & Atkinson	North Hyden	Karlgarin ...	do. ...	24	9	8	14	14	69
ZONE 8.—Judge: N. Davenport, Senior Agricultural Adviser.									
Davis, E. ...	Kebaringup	Gnowangerup	Bencubbin	41	9	9	14	14	87
McDonald, J. ...	Gnowangerup	do.	do. ...	34	9	8	14	14	79
Richards, A. ...	South Caroling	Royal ...	Gluclub ...	33	9	9	14	13	78
Fleay & Sons ...	Wickepin ...	Wickepin ...	Totadgin	32	8	9	13	13	75
Doncon, E. ...	do. ...	do. ...	Bencubbin	30	9	8	14	13	74
ZONE 9.—Judge: A. S. Wild, Senior Agricultural Adviser.									
Campbell, J. ...	Mt. Short ...	Phillips River	Bencubbin	28	9	8	13	12	70
Barrett, M. ...	Ravensthorpe	do. ...	do. ...	26	9	8	13	13	69

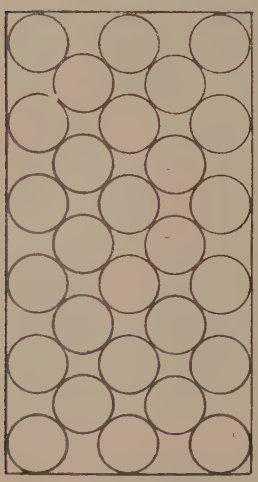
PACKING CHART FOR AUSTRALIAN DUMP CASE.

A. FLINTOFF,
Senior Horticultural Instructor.

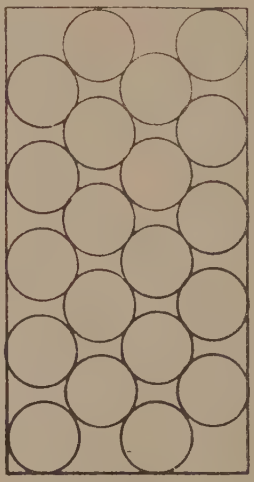
Dimensions of Case.—Length 18in.; width 8⅜in.; Depth 14½in.

DIAGRAM 1.

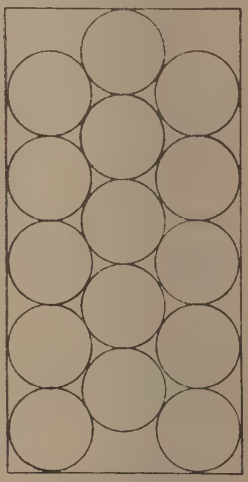
Showing method of placing Apples in case. First and subsequent odd numbered layers.



3—2 Pack.



2—2 Pack.



2—1 Pack.

The "name" or "description" of the pack is determined by the number of apples which are placed across the case in the first two rows, on the bottom and subsequent layers. Thus, if in the first row there are three apples, and in the second row two, the pack will be known as the 3—2 pack, or, if there are two in each row, as the 2—2 pack. Similarly, the 2—1 pack has two apples in the first row and one in the second.

The number of apples placed lengthwise in the case will depend on their size and shape. Suitable numbers for different types of apples, also the number of layers and total number of apples are given in the accompanying table.

DIAGRAM 2.

Alternate layers are placed in spaces in the layer underneath.

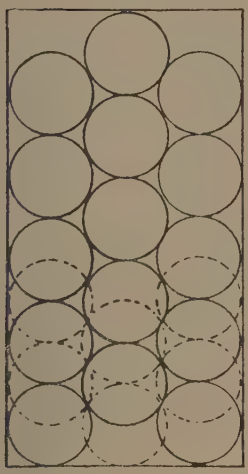


DIAGRAM 3.

The packed fruit should extend about ¾in. above top of case before lidding.

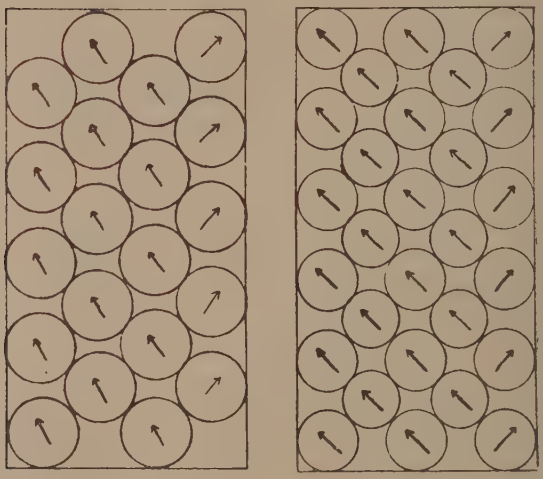
In the second and subsequent layers the apples should not be placed directly on the ones underneath, but placed directly in the depressions, as shown by the dotted line in Diagram 2.

The number of layers in a case will depend upon the size of the apples. Small sized apples with 5, 6, and 7 layers are usually packed tightly and called "Tight" packs. Larger sizes are packed more openly and are called "Free" packs. The "Tight" packs should project above the top less than the "Free" packs. The height of the packed fruit above the top of the case should be approximately ¾in. (See Diagram 3.)

DIAGRAM 4.

Showing "Diagonal Cheek" Pack for long and medium long types.

2—2 Pack. 3—2 Pack.



There are two methods of placing or packing the apples in the layers. These are according to the relation of the line of core—as indicated by the position of the calyx—to the side of the case. The arrows indicate line of core and direction of calyx.

When the line of core is parallel with the side of the case this type of packing is named the "Straight Cheek" pack. When the line of core is approximately in line with a diagonal of the case it is called the "Diagonal Cheek" pack. The stem ends of apples must not face the side of the case in any pack.

TABLE SHOWING COUNTS AND TYPE OF PACK MOST SUITABLE FOR APPLES OF DIFFERENT SHAPES AND SIZES.

APPLE PACKS.

Size dia.	Count.	Layer.	Total No.	Remarks.
	Flat Type.			
2¾in.	3—3 x 6—6	8	288	Diagonal Pack.
2¾in.	3—2 x 8—7	7	263	do. do.
2¼in.	3—2 x 7—7	7	245	do. do.
2¼in.	3—2 x 7—6	7	228	do. do.
2¼in.	3—2 x 6—6	7	210	do. do.
2¼in.	3—2 x 6—5	7	193	do. do.
2¼in.	3—2 x 5—5	7	175	do. do.
2¼in.	2—2 x 7—7	6	168	do. do.
2¼in.	2—2 x 7—6	6	156	do. do.
2¼in.	2—2 x 6—6	6	144	do. do.
2¼in.	2—2 x 6—5	6	132	do. do.
3in.	2—2 x 5—5	6	120	do. do.
3in.	2—2 x 5—4	6	108	do. do.
3in.	2—1 x 8—7	5	113	Straight Pack.
3¼in.	2—1 x 7—7	5	105	do. do.
	Round Type.			
2¼in.	3—3 x 6—5	8	264	Diagonal Pack.
2¼in.	2—2 x 9—9	7	252	Straight Pack.
2¼in.	2—2 x 9—8	7	238	do. do.
2¼in.	2—2 x 8—8	7	224	do. do.
2¼in.	2—2 x 8—7	7	210	do. do.
2¼in.	3—2 x 6—5	7	193	Diagonal Pack.
2¼in.	3—2 x 5—5	7	175	do. do.
2¼in.	3—2 x 5—4	7	158	do. do.
2¾in.	2—2 x 6—6	6	144	do. do.
2¾in.	2—2 x 6—5	6	132	do. do.
2¾in.	2—2 x 5—5	6	120	do. do.
	Long Type.			
2¼in.	2—2 x 8—7	7	210	Straight Pack.
2¼in.	2—2 x 7—7	7	196	Diagonal Pack.
2¼in.	2—2 x 7—6	7	182	do. do.
2¼in.	2—2 x 6—6	7	168	do. do.
2¼in.	3—2 x 5—4	7	158	do. do.
2¼in.	2—2 x 5—5	7	140	Straight Pack.
2¾in.	2—2 x 6—5	6	132	Diagonal Pack.
2¾in.	2—2 x 5—5	6	120	do. do.
2¾in.	2—2 x 5—4	6	108	do. do.
3in.	2—2 x 4—4	6	96	do. do.
	Medium Long Type.			
2¼in.	2—2 x 8—8	7	224	Straight Pack.
2¼in.	2—2 x 8—7	7	210	do. do.
2¼in.	2—2 x 7—7	7	196	do. do.
2¼in.	2—2 x 7—6	7	182	do. do.
2¼in.	3—2 x 5—5	7	175	Diagonal Pack.
2¼in.	3—2 x 5—4	7	158	do. do.
2¼in.	2—2 x 5—5	7	140	Straight Pack.
2¾in.	2—2 x 6—5	6	132	Diagonal Pack.
2¾in.	2—2 x 5—5	6	120	do. do.
2¾in.	2—2 x 5—4	6	108	do. do.
3in.	2—2 x 4—4	6	96	Straight Pack.
3¼in.	2—1 x 6—5	5	83	Diagonal Pack.

RED-LEGGED EARTH MITE.

Halotydaeus destructor (Tucker).

(By L. J. Newman, Government Entomologist.)

Last autumn and early winter witnessed considerable and unusual damage to young wheat crops by this pest.

The principal factor which predisposed the wheat to this injury was the lack of sufficient rain. Damage to plans by sucking insects is greatly accentuated when the plants are unable to replace the loss of sap through the lack of soil moisture. There was sufficient rain to bring up the crops and to hatch out the over-summering mite eggs. Following this there was not enough rain to maintain a good healthy growth of the wheat, weeds died out, the crops wilted and stagnated in growth. The only green plant life left was the struggling wheat or oats.

The mites swarmed on to these, with the result that the death of the plants was hastened. In any case these crops would in the main have failed through drought. The mite, being the most obvious thing present, was in many cases blamed for the death of the crops, whereas it was only a contributing factor, due to the exceptionally unfavourable season.

These first-swarm mites found sufficient food in the drying wheat to carry them through to the egg-laying stage. These eggs then remained dormant until sufficient rain fell later to produce another hatching.

It has been proved that the mite eggs will not hatch under dry conditions. The point I wish to stress is that under normal seasonal autumn conditions with sufficient rains to maintain a continuous growth, the crop would have quickly outgrown the pest with little ill-effect from the mite.

It is only, therefore, during unfavourable autumns that serious damage to wheat crops by the earth mite can be expected. This mite is of great economic importance as a pasture pest. It has a very definite preference for clovers, which at present constitute the chief plants in our grass lands.

The unfortunate position is that the hatching of the mites synchronises with the germination of the seeds. Early out of season rains do not cause the eggs to hatch. It appears to be necessary not only for the land to become moist, but it must remain in this condition and the relative humidity and moisture saturation of the atmosphere must take place before the aestivating or over-summering eggs will hatch. This condition normally occurs any time after mid-April, according to the season. The newly hatched mites at once turn their attention to the young clovers and other seedlings. This constitutes a very serious check upon their growth, as the chlorophyll or green matter of the leaf is removed. Since plants manufacture their food supply largely in their leaves, any excess foliage injury, particularly when young, will greatly reduce their vitality and crop return, and if persisted in will ultimately cause death.

Unfortunately, little heed is taken of the presence of the initial autumn outbreak. It is not until mid-June that the seriousness of the trouble becomes really apparent. By this time a winter generation has been produced, the mite appearing in countless myriads. A general outcry when it is too late is then made as to what can be done to stem the trouble. The young clovers and other fodder plants, when badly attacked, instead of growing and producing early feed turn yellow,

and in many instances die. Potato and pea crops are invaded and become stunted, and likewise ruined. In the flower and vegetable gardens the seedlings are attacked and so checked that the plants, at best, make a most disappointing showing. In small areas methods of control can be satisfactorily applied.

The big issue, however, in regard to this pest, is the very serious damage done by it to our pastures. Clovers have undoubtedly proved to be most adaptable to our South-West, Avon Valley, and Great Southern areas. By means of these legumes, supplemented by top-dressing with manure, the cattle and sheep carrying capacity of these lands has been greatly increased. Subterranean clover of various strains has proved the most prolific to date. Clovers, unfortunately, are particularly subject to insect attack. Not only is the mite seriously injuring them, but also two other pests, namely the Lucerne Flea and the Clover Weevil.

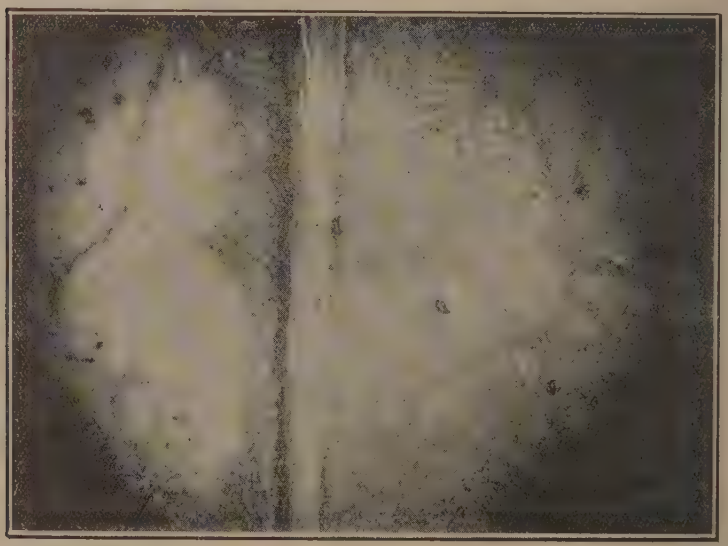


Fig. 1. (Original.)
Eggs of mite on leaf surface, greatly magnified.

I do not wish to be regarded as a pessimist, as I do not doubt that ways and means to cope with these troubles will be found. Facing facts as they are at present I fear that we are placing all our eggs in one basket, so to speak, when we rely upon clovers as our main pasture crop. Clovers will no doubt always play an important part in the stock-carrying capacity of our lands. The time has arrived, however, when the need for more effort to establish mixed pastures should be made. Clovers, which at present in many districts constitute 80 per cent. of the pasture, from a cattle dietetic point of view, are not in themselves a complete food ration, hence the need for growing other crops which are not relished by these pests may not be an unmixed blessing.

Cereal crops are not usually seriously menaced. Oats are attacked, but appear to outgrow the trouble. Should the pest increase its attack upon cereals, it can be controlled by fallowing. The mite is particularly bad in the Avon Valley and

Great Southern areas. The coastal country and the South-West are also infested, but in these districts its ravages have not generally been so disastrous, owing to the fact of the milder climate inducing a more rapid plant growth during the winter.

The pest generally originates in the home garden, where it has been introduced per medium of seedlings or cuttings from infested gardens. The mite has a great variety of host plants, being most cosmopolitan in its tastes. This fact renders its control doubly hard. Cape weed, chick weed, and many others are prolific carriers of the pest. The incidence of this plant-feeding mite has entailed much work upon the entomologist staff in studying its life history and habits. A great deal of time has also been devoted to devising ways and means for its prevention and treatment.

Prevention.—Having proved that the mite is carried over from late spring to autumn per medium of aestivating or over-summering eggs, the following advice is tendered. *The most important means of control is to place the land to be cropped the next autumn under clean fallow during the previous early spring.* Land to be so treated should be heavily stocked to eat down all feed present. This will enable the land to be ploughed with greater certainty of turning under completely all growth. The fallow must be kept free of any further growth until worked and resown the following autumn. The land should be cultivated down to a good tilth with a compact sub-surface. *If the following is done early enough there should not be any over-summering eggs present.* Allow at least two weeks to elapse after the first autumn rains before harrowing and re-sowing the crop, which should be clovers and other approved pasture plants. This period after the rains will permit of any mite eggs that may be present to hatch in the inpacted sub-surface soil, where they will die owing to being unable to reach the surface. If this method, which is recommended every third or fourth year, does not prove 100 per cent. effective, it will at least so check the pests that it will ensure the life of the pasture for a period of three or four years or longer. Eventually the mite and other insect pests will have again increased to plague form, necessitating a repetition of this work. The turning over of the land not only assists in the checking of the insects, but also improves the growth and feeding value of the following crops.

Autumn treatment.—If the land has not been placed under fallow the previous early spring, a good check can be administered by thoroughly ploughing and turning in the young mites. These mites arise from the over-summering eggs, and will hatch about two weeks after the first genuine autumn rains. It is most important to take action, whether it be ploughing, dusting, or spraying, to check this pest before winter eggs have been laid. The winter eggs are laid upon the foliage. Infinitely better results will follow action taken then than later, when myriads of winter eggs have been deposited. Two weeks, therefore, after the first mites are observed, ploughing or other treatments should be undertaken. Ten days after preparing the land the crop can be sown. As a further protection against invasion from contiguous infested areas keep a strip of cultivated land about 20 feet wide around the crop. The mites cannot readily pass over a loose buffer.

The fact that the mite floats in myriads on the surface of running water is a factor that has to be considered. A portion of land that has been treated, as before described, may be reinfested by the introduction of the mite from contiguous infested areas by this means. It is, therefore, essential to see that any running water is diverted by means of drains from the land to be protected. The use of forcing

manures as the first top-dressing of the pasture in the autumn is advised. This will assist the young seedling plants to grow rapidly, and thus get ahead of the mite. If this growth can be maintained, then there is a good chance of the damage

Fig. 2. (Original.)
Adult female, dorsal view, magnified by 20.

Fig. 3. (Original.)
Adult female, ventral view, magnified by 20.

Fig. 4. (Original.)
Adult female, magnified by 20.

Fig. 5. (Original.)
Adult female, ventral view, showing eggs in body, magnified by 20.

now suffered being greatly reduced. If the seedling plant growth is slow the mites are able to destroy the leaves more rapidly than they are produced, hence many plants die, or their growth is so retarded that they are rendered useless as early

winter feed. Later on, as the weather warms up in the spring, they may eventually outgrow the attack. One of the principal objects of growing clovers, however, is to obtain early feed. Never transfer seedling plants or cuttings from a mite-infested area to a clean one. This is one of the most prolific means of spreading the pest. It will always pay to raise one's own plants from seed. Sheep are also spreaders of the mite. The mites crawl on to the sheep whilst feeding or lying down. The sheep are then moved to another paddock or may even be transported some considerable distance. A fresh outbreak of mite is then established, and hence by these means this wingless creature is spread. Keep down all weeds and rubbish that offer breeding mediums and shelter to the mites.

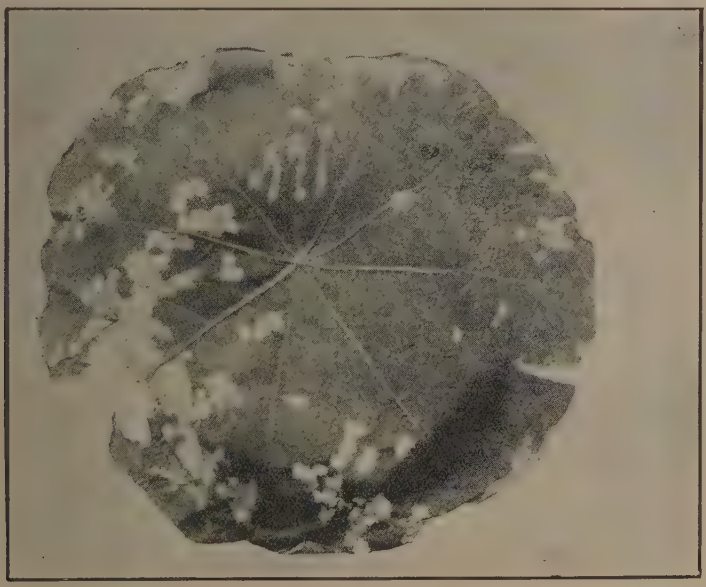


Fig. 6. (Original.)
Leaf of plant showing typical injury caused by mite.

Treatment.—During the past few years a great deal of experimental work against this pest has been done with the view of finding the most economical means of combating it. The difficulty lies in the widespread nature of the trouble. Not only are the garden and useful pasture plants attacked, but all kinds of weeds are used as host plants. The question is one of economics. The cost of so many sprays and dusts that would effectively kill the mite render their use over large areas out of the question.

For crops such as potatoes, vegetables, flower gardens and limited pasture areas the following sprays or dusts can be effectively used. To be of maximum use they should be applied two weeks after the first mites have been observed in the autumn:—

Disinfectant phenyle, 1 part to 80 parts of water, applied with sprayer, not watered on, will destroy all mites brought into contact.

Izal, 1 part to 250 parts of water, is effective. To this may be added 5 gallons of lime and sulphur liquid, thus making a solution that will destroy both mites and Lucerne Flea. Black leaf 40 1 pint, soap 3 lbs., water 70 gallons is an effective spray.

A home-made spray.—Sunlight soap ½ lb., turpentine 8 tablespoonfuls, water 4 gallons. Shred the soap and dissolve by boiling in 2 gallons of water. Remove from fire, allow to cool slightly, then add the turpentine and thoroughly stir into an emulsion. Make up to 4 gallons with hot water. Apply with spray pump whilst hot.

Kerosene and naphthalene emulsion is good. Kerosene 2 gallons, soap half a pound, naphthalene half an ounce. Dissolve the naphthalene in the kerosene, shred the soap, dissolve by boiling in one gallon of water. Remove from fire and add to the kerosene naphthalene, churning violently for 8 to 10 minutes. This will form an emulsion, which thickens on cooling. When using take one part of this stock to 8 parts of water.

As a dusting powder mix the following:—1 lb. of 15 per cent. carbolic powder, 4 lbs. superphosphate or other finely ground manure. These are thoroughly mixed, giving a 3 per cent. carbolic content. Use as a top-dressing at the rate of at least one cwt. per acre. The carbolic powder may be used with lime, tobacco dust, or other suitable diluent. The advantage of using the manure mixture is that it combines a fertiliser and mitecide, thus not only killing the mite, but in the same act and at the one cost of labour, manuring the crop.

A dusting for gardens can be made by mixing the following:—½ pint of kerosene, mixed thoroughly with ½ a kerosene tin of tobacco dust and an equal part of slaked lime. Allow to stand all night before using.

Flaked naphthalene dusted around plants and over seed beds will both kill and repel the mite. A band of creosote painted around a seed bed will definitely repel the mite.

There are a number of proprietary sprays and dusts that can be effectively used against this pest.

Burning off.—If possible the passing of a good slow-burning fire against the wind is advised. The burn must be a hot one, otherwise the destruction of the eggs will only be partial. The need for retaining the dry feed renders this method impossible in many cases.

Biological control.—Very little appears to be known of natural enemies of mites. Control by parasites may some day be successfully employed, but to date no effective parasite has been discovered.

PASTURE DEVELOPMENT.

Progress Report on Rotational Grazing Demonstration under Irrigation Conditions, Roelands.

G. K. BARON-HAY,
Superintendent of Dairying,

The State Committee of the Australian Dairy Council during 1934 made available sums of money to be used towards demonstrating to dairy farmers the value of subdivision for increasing the carrying capacity of holdings.

As large areas totalling approximately 35,000 acres recently had been converted from dry farms into irrigation farms, and little information was available regarding the most economical method of developing permanent pasture on the types of soil represented, the State Committee decided to co-operate with the Department of Agriculture in establishing a demonstration area on the property of Mr. A. E. Jackson, Roelands. 12.9 acres of land which had been cultivated previously were subdivided into five paddocks of approximately 2.5 acres each with permanent water laid on to each paddock.

The area when taken over for the demonstration had a crop of oats growing upon it. This crop was fed off during the winter months, the whole area being thoroughly ploughed with a mouldboard plough on 15th September, 1934, ploughing being completed by 17th October. The area was then harrowed in preparation for seeding.

The objects of the demonstration included:—

1. The collecting of information as to whether it would be more profitable to establish permanent pasture with a cover crop than to sow the permanent pasture seeds alone.
2. Information regarding the most suitable plants for the establishment of permanent pasture under irrigation conditions.
3. The collection of data regarding carrying capacity on small irrigated areas.
4. The collection of data to show the change in composition due to rotational grazing under irrigation conditions.

Soil.—The soil consists of a red to brownish clay loam situated at the foot of the Darling Range near Roelands Siding. The area is capable of good drainage and is typical of large areas of land in the vicinity, the timber being originally red gum, jarrah, and some wandoo.

Seed Mixtures.—Seed mixtures were sown as follows from 8th to 12th November, 1934, and then rolled on 19th and 20th November, 1934:—

Plot 1—Sudan Grass 7 lb. + Paspalum dilatatum 10 lb. + Certified N.Z. White Clover 2 lb. per acre.

Plot 2—Italian Rye Grass 7 lb. + Paspalum dilatatum 10 lb. + Certified New Zealand White Clover 2 lb. per acre.

Plot 3—Japanese Millet 5 lb. + Paspalum dilatatum 10 lb. + Certified N.Z. White Clover 2 lb. per acre.

Plot 4—Perennial Rye Grass 7 lb. + Paspalum dilatatum 10 lb. + Certified N.Z. White Clover 2 lb. per acre.

Plot 5—No cover crop. Paspalum dilatatum 10 lb. + Certified N.Z. White Clover 2 lb. per acre.

Fertiliser.—2 cwts. of super and ammonia No. 3 manure per acre was applied at the time of planting, followed by a dressing of 1 cwt. before watering in January, and 70 lb. per acre before watering in February. During the third week in April, 1935, 2 cwts. of superphosphate and 56 lb. sulphate of ammonia per acre were applied to the five plots.

As it was thought probable that the continued use of sulphate of ammonia might seriously deplete the quantity of lime in the soil, in order to obviate this and to give some information regarding the continued application of ammonia to pasture, two-thirds of the area of each plot received a dressing of 3½ cwts. of lime per acre in June, 1935. Since that date superphosphate only has been applied—2 cwts. on 5th August and 1 cwt. on 12th December, 1935.

It will thus be seen that during the twelve months the area received approximately 9 cwts. of fertiliser per acre.

Cultivation.—The standard treatment of the area was a thorough harrowing immediately before watering and, if considered necessary, an application of superphosphate as a top-dressing.

Watering.—The area was watered on five occasions during the twelve months, namely, 6th December, 29th December, 1934, 29th January, 1935, 27th February, and 14th December. The cost of these five waterings totalled 17s. 6d. per acre.

The plots were visited at regular intervals with a view to obtaining information regarding the Botanical composition, which was taken by means of a quadrat thrown at random at least 20 times on each plot.

Table 1 shows the Grazing Days which were obtained per month on each plot:—

TABLE 1.

Month.	Cow Grazing Days (8 hours) per Acre.					Total Grazing Days per Month.	Average Grazing Days per Acre per Month.
	Plot 1.	Plot 2.	Plot 3.	Plot 4.	Plot 5.		
January* ...	32·4	14·6	81·2	21·4	9·6	159·2	31·86
February ...	22·2	30·2	36·1	21·6	23·0	133·1	26·62
March	22·2	23·0	22·2	37·1	41·3	145·8	29·16
April	13·5	18·5	6·0	25·1	18·1	81·2	16·24
May	29·8	32·6	15·6	45·1	16·7	139·8	27·96
June	50·8	38·4	39·9	62·5	...	191·6	38·32
July	...	...	...	...	...	...	...
August	18·0	22·8	16·0	24·7	17·1	98·6	19·72
September ...	9·0	13·5	5·6	14·6	35·3	78·0	15·60
October	46·6	45·8	47·5	50·7	52·5	243·1	48·62
November ...	48·8	43·6	35·0	63·0	83·5	273·9	54·80
December ...	67·0	50·2	48·0	65·1	90·6	321·9	64·38
Total ...	360·3	333·2	353·1	430·9	387·6	1,866·2	373·28
Average ...	30·02	27·77	29·42	35·91	32·3	155·5	31·1

* In January is included last 10 days of December, 1934, for plots Nos. 1 and 3 only.

Plots 1-4 were excessively grazed during June, 1935.

Carrying capacity of total area = 1 cow to 0.973 acres.

Total Grazing:—

38,372.8 grazing hours in 365 days off 12.895 acres.
= 4,796.6 grazing days of 8 hours each
= 371·2 grazing days per acre,
or 1 cow to 0.973 acres.

It will be seen from Table 1 that Plots 1 to 3 gave considerably greater grazing during several months soon after planting, as would be expected from the provision of a cover crop of a rapidly growing annual. By the end of the summer months, however, i.e., April, it was found that those areas which had been planted without a cover crop, particularly Plot 4 containing Perennial Rye Grass, was giving considerably more feed owing to the fact that the cover crop had resulted in a depression of the smaller growing permanent pasture plants.

It will be noticed that during July no grazing was obtained from any plot and that unusually high grazing was obtained during June. This is an indication of the danger of over-grazing permanent pasture, particularly during the early stages of development, as it took two months for the plots to recover from the heavy grazing in June.

During the remainder of the year, August to December, good grazing was obtained from all plots, but almost throughout the year Plot 4, containing a mixture of Paspalum dilatatum, Perennial Rye Grass and White Clover, has provided the most feed, and this mixture is recommended for sowing on irrigated areas for permanent pasture.

It will be seen that the whole area, during its first year of establishment, resulted in the very high-carrying capacity of just under 1 acre per cow.

BOTANICAL ANALYSIS.

In June, some six months after the establishment of the plots, it was considered advisable to carry out monthly Botanical analyses on each plot to determine, during the first year, the effect of the cover crops on the ultimate pasture, and also to determine through what period each constituent of the pasture was at its best growth. This information would give an excellent guide as to what type of pasture mixture would give all year round grazing.

From the figures obtained to date, it appears as if a mixture consisting of Perennial Ryegrass, Paspalum, White Clover and Subterranean Clover would be the ideal type. Of the grasses, Ryegrass gives good early autumn, winter, and spring growth, the Paspalum early summer to autumn growth; White Clover is obtainable the year round, and Subterranean Clover gives a flush growth during the late winter, spring, and early summer months.

Subterranean Clover has one disadvantage—that it is likely to dominate the sward during the late spring months giving a more or less one-type pasture if not efficiently grazed. Where grazing is controlled a good balanced pasture should be maintained, providing the pasture is efficiently fertilised, renovated and watered.

From the analysis it will be seen that the various cover crops used had varying effects on the Paspalum-White Clover ratio.

In June, on Plot 5, which was sown without a cover crop, the Paspalum content was 52 per cent and the White Clover 34 per cent. Using this as a basis, the following table gives the percentage for the five plots, four of which had cover crops.

TABLE 2.

	Paspalum.	White Cover.	Total Cover.
	%	%	%
Plot 5—No cover crop	52·0	34·0	96·8
„ 1—Sudan crop*	41·0	13·0	89·9
„ 2—Italian Rye crop	26·0	4·0	94·0
„ 3—Jap Millet crop	41·0	1·4	78·4
„ 4—Perennial Rye crop	38·0	3·5	93·5

*Sudan partial failure owing to late watering.

From the above figures it will be seen that the cover crops did not have a very large influence on the stand obtained from the Paspalum. From this we may safely say that cover crops can be utilised for the establishment of Paspalum.

The figures, however, do show that in every case where a cover crop was used, the percentage cover of White Clover was considerably reduced, and that the heavier the growth of the cover crop the lower the percentage of White Clover. An interesting feature is the way in which both of the Rye Grasses, which were incorporated, affected the percentage cover of White Clover.

The analyses obtained for July are given in Table 3.

TABLE 3.

	Paspalum.	White Clover.	Total Cover.
	%	%	%
Plot 5—No cover crop	36·3	45·0	86·8
„ 1—Sudan crop	33·4	12·7	86·1
„ 2—Italian Rye crop	25·2	4·5	78·6
„ 3—Jap Millet crop	39·4	5·5	80·6
„ 4—Perennial Rye crop	30·7	11·0	82·4

Paspalum.—Although the actual percentage of Paspalum had decreased owing to the cold conditions, the percentage in each plot remained fairly constant.

White Clover.—A considerable increase in the percentage cover in Plot 5 is noticeable. It also is obvious that the percentage cover in the other plots is increasing. This was to be expected owing to the seasonal conditions favouring clover growth.

Table 3 gives the analyses for August.

TABLE 4.

	Paspalum.	White Clover.	Total Cover.
	%	%	%
Plot 5—No cover crop	22·1	51·1	84·7
„ 1—Sudan crop	18·3	27·7	76·2
„ 2—Italian Rye crop	15·9	12·6	86·0
„ 3—Jap Millet crop	25·8	7·5	79·5
„ 4—Perennial Rye crop	24·9	14·6	78·9

Paspalum.—A still steady decline in cover is recorded. This should remain the case until the advent of the warmer weather.

White Clover.—An increase in percentage cover is obvious in all plots. It is quite reasonable to assume that, if the Sudan had been successful, the percentage of White Clover in that plot would have been on par with the other plots having cover crops.

Total Cover.—Very little variation is noticeable on all plots.

Table 4 gives the results of analyses for September.

TABLE 5.

	Paspalum.	White Clover.	Sub. Clover.	Total Cover.
	%	%	%	%
Plot 5—No cover crop	9·3	50·3	38·4	99·2
„ 1—Sudan crop	26·6	31·2	9·6	86·9
„ 2—Italian Rye crop	19·8	19·7	12·6	80·4
„ 3—Jap Millet crop	40·6	18·4	9·0	92·9
„ 4—Perennial Rye crop	25·9	13·9	8·2	89·6

Paspalum.—The most noticeable feature here is the big decrease in percentage cover of Paspalum in Plot 5. This was due to the rapid increase of Subterranean Clover.

White Clover.—The percentage cover of White Clover on Plots 1-4 is increasing rapidly.

Table 5 gives the results of analyses for October, 1935.

TABLE 6.

	Paspalum.	White Clover.	Sub. Clover.	Total Cover.
	%	%	%	%
Plot 5—No cover crop	17·4	67·6	12·6	98·1
„ 1—Sudan crop	35·0	39·3	6·3	92·2
„ 2—Italian Rye crop	26·5	33·0	13·8	95·5
„ 3—Jap Millet crop	46·9	14·2	4·8	94·7
„ 4—Perennial Rye crop	28·2	28·2	5·7	95·3

Paspalum.—All plots showing a steady increase in the percentage cover of Paspalum.

Clovers.—White Clover still maintaining vigour. The bulk of the grazing obtained during the month was from the clover content of the pastures.

Total Cover.—Very little bare ground present on all plots.

Table 6 gives the results of analyses for November, 1935.

TABLE 7.

	Paspalum.	White Clover.	Sub. Clover.	Total Cover.
	%	%	%	%
Plot 5—No cover crop	39·6	50·7	5·5	98·0
„ 1—Sudan crop	36·0	49·4	5·6	99·3
„ 2—Itaiian Rye crop	22·2	43·8	8·1	99·5
„ 3—Jap Millet crop	31·3	22·5	2·5	97·5
„ 4—Perennial Rye crop	22·7	43·6	4·2	96·7

Paspalum.—Plots 2 and 4, which had cover crops of Italian and Perennial Rye Grass respectively, show lower percentages of cover of Paspalum than is the case with the other plots.

White Clover.—The only plot which is not yet showing a high percentage of White Clover is Plot 3, which had a cover crop of Japanese Millet. It is obvious that the Millet had a retarding effect on the development of White Clover.

Total Cover.—All plots are showing practically total cover.

Table 7 gives the results of analyses for December, 1935.

TABLE 8.

	Paspalum.	White Clover.	Total Cover.
	%	%	%
Plot 5—No cover crop	49·7	49·4	99·4
„ 1—Sudan crop	38·2	36·5	98·0
„ 2—Italian Rye crop	40·3	24·4	97·3
„ 3—Jap Millet crop	41·9	23·1	94·5
„ 4—Perennial Rye crop	49·1	27·3	95·6

Paspalum.—In every plot the Paspalum is showing increased vigour and a higher percentage of cover. This is due to the higher temperatures prevailing and the start of irrigation.

White Clover.—Showing a slight decline in percentage cover, no doubt due to the vigour of the Paspalum.

Rye Grasses.—Table 8 shows the percentage of Rye Grasses present in Plots 2 and 4 for the seven months.

TABLE 9.

	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Plot 2—Italian Rye Grass ...	26·2	17·8	10·0	13·7	6·9	2·6	4·4
„ 4—Perennial Rye	37·4	29·4	28·5	29·4	26·0	15·4	13·3

This table shows a steady decline in both types. Undoubtedly the Italian Rye Grass is gradually going out, and it will remain to be seen what percentage cover the Perrenial Rye Grass will maintain throughout the coming season.

Tentative Conclusions drawn from the above Botanical Analyses.

1. That all rapid growing cover crops have a detrimental effect on the initial establishment of White Clover.
2. That rapid growing cover crops have very little influence on the ultimate stand of Paspalum.

3. That rapid growing cover crops are not recommended when establishing a permanent pasture under irrigation.
4. Taking into account the results from "Rate of Seeding" trials for the establishment of pasture reported elsewhere, the following mixture is recommended for land which has been cultivated previously and can be irrigated:—

Certified Perennial Rye Grass	5 lb. per acre.
Paspalum dilatatum	8 „ „ „
Certified N.Z. White Clover	2 „ „ „

5. While the initial application of 2 cwts. of super and ammonia No. 3 is recommended when sowing the seeds, in order to stimulate the Rye Grass, subsequent applications of fertiliser should be of superphosphate only until further information is available.

RESULTS OF FERTILISER TRIALS UNDER CONTROLLED METHODS OF GRAZING.

G. K. BARON-HAY,
Superintendent of Dairying,
and
H. G. ELLIOTT,
Agricultural Adviser.

During the season 1931-32 Cuming Smith & Mt. Lyell Farmers' Fertilisers Ltd., in co-operation with Nitrogen Fertilisers Pty. Ltd., decided to conduct fertiliser trials under a controlled system of grazing, with a view of obtaining information regarding what part additions of nitrogenous fertilisers may play in pasture development.

The cost involved in carrying out the six trials reported hereunder has been generously borne by the above firms, whose field officer, Mr. G. N. Lowe, in close co-operation with the Department of Agriculture, supervised the conduct of the trials.

Trials have been carried out in the following centres:—Kendenup, Serpentine, Cookernup, North Dandalup, Wonnerup, and Kulikup.

It was recognised at the outset that, as far as this State was concerned, the limiting factors of rotational grazing were as follow:—

(1) The uneven distribution of the annual rainfall, resulting in a distinct dry period and a wet or growing period.

(2) Low nitrogen content of soils throughout the areas of high winter rainfall.

(3) The botanical composition of existing pastures which were mainly composed of annual clovers.

Object.—The trials were designed to yield information on the following:—

(1) Whether an addition of sulphate of ammonia to the superphosphate ordinarily used would yield increased grazing.

(2) What quantity of sulphate of ammonia, if any, is profitable.

(3) The ultimate effect of the sulphate of ammonia on the botanical composition of the pasture.

TABLE 1.

MONTHLY RAINFALL AT EXPERIMENTAL CENTRES.

(Average.)

Month.	Kendenup.	Serpentine.	Harvey.	Busselton.	Kulikup.	North Dandalup.
January	60	39	44	41	41	48
February	64	42	52	45	29	23
March	122	86	79	89	116	119
April	177	162	174	138	180	196
May	309	604	571	473	335	692
June	332	784	811	670	420	754
July	391	792	784	643	415	870
August	327	594	602	451	318	633
September	297	422	455	306	280	442
October	246	248	294	232	154	293
November ...	110	84	105	86	65	86
December	85	49	58	51	54	40
Total ...	2,520	3,906	4,029	3,225	2,407	4,196

It will be seen from the above that, with few exceptions, the useful rains occur during the six months May to October.

The following gives the results of the trials:—

F. Walton Rowe, Kendenup.

The trial on this property consisted of five plots each of two acres, or a total of 10 acres.

Soil.—Deep sandy loam well drained and carrying in its native state jarrah and red gum. Prior to planting, the land was carrying ordinary "native" grasses and scrub. After a thorough discing with disc harrows, followed by a good harrowing, it was sown in the early winter of 1931 with a mixture of perennial ryegrass, cocksfoot, and white clover.

Fertilisers.—The following fertilisers were used from 1932:—A basal dress of 2 cwts. of superphosphate per acre was used with additions of sulphate of ammonia from ½ cwt. to 2 cwts. per acre, as follows:—

Plot 1.—Superphosphate 2 cwts. + Sulphate of Ammonia 2 cwts. per acre.
Plot 2.—Superphosphate 2 cwts. + Sulphate of Ammonia 1½ cwts. per acre.
Plot 3.—Superphosphate 2 cwts. (Control.)
Plot 4.—Superphosphate 2 cwts. + Sulphate of Ammonia 1 cwt. per acre.
Plot 5.—Superphosphate 2 cwts. + Sulphate of Ammonia ½ cwt. per acre.

On strips across these plots lime 4 cwts. per acre and muriate of potash ½ cwt. per acre were applied annually.

Each plot has been topdressed annually during the early autumn with the above fertilisers, and harrowing has been carried out at intervals when required.

Early in the autumn, 1935, the plots were thoroughly renovated with a spring-toothed cultivator to which pasture points had been attached, which was the first cultivation other than normal harrowing which they had received.

The pasture now consists mainly of subterranean clover and white clover with perennial ryegrass, cocksfoot having failed to persist during the dry summer months.

TABLE 2.

ANNUAL GRAZING OBTAINED FROM EACH PLOT—SHEEP.

F. Walton Rowe, Kendenup.

Plot No.	Carrying capacity per acre. Average 4 years.	1932. Total Sheep Grazing Days per annum—2 acres.	1932. Carrying capacity Sheep per acre per annum.	1933. Total Sheep Grazing Days per annum—2 acres.	1933. Carrying capacity Sheep per acre per annum.	1934. Total Sheep Grazing Days per annum—2 acres.	1934. Carrying capacity Sheep per acre per annum.	1935. Total Sheep Grazing Days per annum—2 acres.	1935. Carrying capacity Sheep per acre per annum.
1 ...	6·10	1,085	1·48	4,106	5·63	6,817	9·34	5,816	8·00
2 ...	5·74	1,085	1·48	4,087	5·60	6,335	8·67	5,255	7·20
3 ...	5·86	949	1·30	3,970	5·44	6,661	9·12	5,499	7·53
4 ...	6·80	1,692	2·32	4,947	6·77	7,412	10·15	5,782	7·92
5 ...	4·80	1,084	1·48	3,294	4·50	4,965	6·80	4,671	6·40
Total ...	...	5,895	...	20,404	...	32,190	...	27,023	..

From the above it will be seen that the average carrying capacity for the four years 1932-1935 was 5.86 sheep per acre. This was also the carrying capacity of Plot 3 which was fertilised with superphosphate 2 cwts. per acre. Very little variation was obtained in grazing days from the other fertiliser treatments. Plot 4—superphosphate 2 cwts. plus sulphate of ammonia 1 cwt.—gave consistently better grazing than the other plots, but did not give more economical returns than Plot 3—superphosphate 2 cwts. per acre.

Phenomenal grazing was obtained during the season 1934. This was due to early rains which gave early grazing in April.

Botanical Analyses.—The botanical analyses of the above plots were carried out during the seasons 1934 and 1935 with the following results:—

PERCENTAGE OF COVER.

	Grass. Aug. 1934.	Grass. Dec. 1934.	Grass. Aug. 1935.	Clover. Aug. 1934.	Clover. Dec. 1934.	Clover. Aug. 1935.	Weeds and Bare Ground. Aug. 1934.	Weeds and Bare Ground. Dec. 1934.	Weeds and Bare Ground. Aug. 1935.
Plot 1.—S2 + A2	29	29	16	61	67	78	10	4	6
„ 2.—S2 + A1½	51	10	27	48	81	61	1	11	12
„ 3.—S2	8	5	11	90	92	82	2	3	7
„ 4.—S2 + A1	22	8	14	78	92	83	...	...	3
„ 5.—S2 + A½	24	7	12	74	90	74	2	3	14

S = Superphosphate. A = Sulphate of Ammonia.

The addition of sulphate of ammonia to the superphosphate application has increased the grass content of the swards. The reduction of the percentage grass in December, 1934, was due to the spreading of the subterranean clover. Very little variation of the above was obtained in the lime and potash strips. The potash, generally speaking, reduced the percentage of grass cover.

Summary.

(1) Grazing trials have been conducted at six centres, over five seasons.

(2) Addition of sulphate of ammonia increased the percentage of grasses in the pasture.

(3) Although superphosphate 2 cwts. plus sulphate of ammonia consistently yielded higher grazing, superphosphate 2 cwts. per acre was the most profitable financially.

(To be continued.)

FERTILISER TRIALS ON IRRIGATED PASTURE UNDER CONTROLLED METHODS OF GRAZING.

An area of land on the property of Mr. J. H. Brett, Dardanup, was selected during the spring of 1934 for the purpose of laying down permanent pasture and endeavouring to obtain information regarding the most economical methods of fertilising irrigated pasture.

The 10 acres selected was contoured for irrigation by the Officer-in-Charge of Irrigation, Mr. A. R. C. Clifton, and divided into three fields of 3 1/3rd acres each.

The fertiliser and seed were supplied by Cuming Smith & Mt. Lyell Farmers' Fertilisers Ltd. and Nitrogen Fertilisers Ltd., who also allowed their Field Officer, Mr. G. N. Lowe, to co-operate with the Department in the conduct of the experiment.

Pasture Mixture.

Western Districts Perennial Rye Grass, 15 lbs.; Certified "Akaroa" Cocksfoot, 3 lbs.; New Zealand Certified White Clover, 2lbs.; Perennial Red Clover, 1 lb., or a total of 21 lb. seed per acre.

The objects of the experiment are:—

(1) To compare in grazing days and observationally the differences between superphosphate with and without additions of sulphate of ammonia;

(2) To ascertain the effect of additions of lime and potash to the above two fertilisers.

The following fertiliser treatments were used:—

Plot 1.—Superphosphate 2 cwts. + sulphate of ammonia 1 cwt. per acre.

Plot 2.—(Control.) Superphosphate 2 cwts. per acre.

Plot 3.—Superphosphate 2 cwts. + sulphate of ammonia 2 cwts. per acre.

All fertiliser applied at time of planting.

On separate strips across the fertiliser treatment, lime was applied at the rate of 4 cwts. per acre and muriate of potash at 56 lb. per acre.

Irrigation was carried out during the summer months by the furrow system.

Harrowing and mowing are carried out as required to stimulate the pastures and spread dung, and to prevent the growth of rank patches.

The system of grazing adopted is that, when the pasture is not more than 4 inches high, close grazing up to 15 cows per acre to be given rapidly and stock removed until the plots are again fit for grazing at that stage.

Records of grazing days were kept separately for each treatment, and botanical analyses were taken at intervals.

Results—First Year.

Six waterings were given during the twelve months as follows:—December 19th, 1934, 22nd January, 16th February, 29th March, 25th November, and 20th December, 1935.

All plots were topdressed with half of the annual fertiliser on 26th April, 1935, the remainder being applied on 20th November, 1935.

The following table gives the results of the first year's grazing figures, and shows the total grazing hours per plot and also per acre.

TABLE 1.

TOTAL GRAZING HOURS AND GRAZING DAYS.

(All Grazing by Cows.)

Month.	Plot 1.—S2 + A1. Total Grazing Hours.	Plot 1.—S2 + A1. Grazing Hours per acre.	Plot 1.—S2 + A1. Grazing Days—8 hours per acre.	Plot. 2.—S2. Total Grazing Hours.	Plot. 2.—S2. Grazing Hours per acre.	Plot. 2.—S2. Grazing Days—8 hours per acre.	Plot 3.—S2 + A2. Total Grazing Hours.	Plot 3.—S2 + A2. Grazing Hours per acre.	Plot 3.—S2 + A2. Grazing Days—8 hours per acre.
*January	1,083	324·9	40·6	508	152·4	19·0	956	286·8	35·8
February	792	207·6	25·9	600	180·0	22·5	625	187·5	23·4
March	639	191·7	24·0	714	214·2	26·8	715	214·5	26·8
April	608	182·4	22·8	530	159·0	19·9	997	299·1	37·4
May	...	...	...	...	...	...	931	279·3	34·9
June	450	135·0	17·0	...	...	...	462	138·6	17·3
July	...	...	...	...	...	...	882	264·6	31·1
August	...	...	...	918	275·4	34·4	...	...	...
September	399	119·7	15·0	1,313	393·9	49·2	806	241·8	30·2
October	1,767	530·1	66·3	1,064	319·2	39·9	168	50·4	6·3
November	979	293·7	36·7	416	124·8	15·6	1,343	402·9	50·4
December	748	224·4	28·1	1,004	301·2	37·6	675	202·5	25·3
Total ...	7,465	2,239·5	279·6	7,067	2,120·1	265·0	8,560	2,568·0	321·0
Average per month	622·1	186·6	23·33	588·9	178·34	22·1	713·33	214·0	26·75
Acres required per Cow per annum ...		1·3			1·38			1·137	

* January includes light grazing during December, 1934. S = Superphosphate.
A = Sulphate of Ammonia.

From the above it will be seen that for the first year Plots 1 and 2 gave good grazing for 9 months of the year and Plot 3 for 11 months. Apparently in Plot 3 the higher rate of sulphate of ammonia increased the rate of growth of the perennial rye grass, and promoted good grazing during the months of May, June, and July. The superphosphate application on Plot 2 did not stimulate rapid growth of clovers during the three cold months, but gave excellent grazing during the months August to October. The second application of superphosphate in November also stimulated the clover growth, but, where sulphate of ammonia was used in conjunction with the superphosphate, the added nitrogen had a depressing effect on the clovers and did not stimulate the grasses sufficiently to make up for this depressing effect.

Grazing.

The following table gives the actual grazing obtained.

TABLE 2.

Plot No.	Fertiliser.	Grazing Days per acre.	Acres required per Cow.	Value of Grazing 2/4 per Cow per Week. £ s. d.
2	Superphosphate 2 cwt.	265·0	1·380	4 8 4
	Superphosphate 2cwt., Sulph. Ammonia 1owt.	279·6	1·300	4 13 2
	Superphosphate 2owt., Sulph. Ammonia 2owt.	321·0	1·137	5 7 0

The above table shows that, during the first year, the added sulphate of ammonia gave extra grazing, but, as is shown below, this increased grazing was not sufficient to compensate for the increased cost of fertiliser.

TABLE 3.

Plot No.	Fertiliser.	Gross Value of Grazing. £ s. d.	*Cost of Fertiliser. £ s. d.	Net Value of Grazing. £ s. d.
2	Superphosphate 2owt.	4 8 4	0 8 0	4 0 4
1	Superphosphate 2owt., Sulph. Ammonia 1owt. ...	4 13 2	1 0 6	3 12 8
3	Superphosphate 2owt., Sulph. Ammonia 2owt. ...	5 7 0	1 13 0	3 14 0

* No freight and cartage allowances.

Botanical Analyses.

Botanical analyses were taken during the year by means of a 10-inch quadrat thrown at random on the plots, the figures shown being the average of 240 readings.

TABLE 4.

Plot No.	Fertiliser.	*Grass.	*Clover.	Weeds and Bare Ground.	Total Clover.
		%	%	%	%
2	Superphosphate 2cwt.	14·0	82·0	4·0	98·0
1	Superphosphate 2cwt., Sulphate of Ammonia 1cwt.	27·0	64·0	9·0	95·0
3	Superphosphate 2cwt., Sulphate of Ammonia 2cwt.	41·0	41·0	18·0	87·0

* Grass mainly Perennial Rye Grass, White Clover predominating in the Clovers.

From the above it will be noted that the addition of 1 cwt. of sulphate of ammonia to the 2 cwt. superphosphate increased the grass content of the pasture from 14 per cent. to 27 per cent., and that the addition of a further 1 cwt. of sulphate of ammonia in Plot 3 increased the grass content to 41 per cent. With the clovers, however, a more or less proportionate decrease occurred where the additional ammonia was added.

The sulphate of ammonia additions, however, increased the "Weed and Bare Ground" percentage considerably, Plot 3 having as high as 13 per cent. bare ground.

Lime.

The following analyses were obtained in this series:—

TABLE 5.

Plot No.	Fertiliser.	Grass.	Clover.	Weeds and Bare Ground.	Total Cover.
		%	%	%	%
2	Lime 4cwt. + Snperphospate 2cwt.	24·0	73·0	3·0	97·0
1	Lime 4cwt. + Superphosphate 2cwt. + Sulphate of Ammonia 1cwt.	37·0	57·0	6·0	95·0
3	Lime 4cwt. + Superphosphate 2cwt. + Sulphate of Ammonia 2cwt.	31·0	57·0	12·0	90·0

Comparing Tables 4 and 5 it will be seen that the addition of lime to the superphosphate treatment had a tendency to increase the grass content and decrease the clover content of the sward.

Where lime was added to plots dressed with sulphate of ammonia, the effect seems to be to more effectively control the growth of weeds than where ammonia was used without lime. Not sufficient information is available on this point yet.

Potash.

Table 6 shows the results of the potash series.

TABLE 6.

Plot No.	Fertiliser.	Grass.	Clover.	Weeds and Bare Ground.	Total Clover.
		%	%	%	%
2	Muriate of Potash ½cwt + Superphosphate 2cwt.	27·0	68·0	5·0	96·0
1	Muriate of Potash ½cwt. + Superphosphate 2cwt. + Sulphate of Ammonia 1cwt. ...	21·0	75·0	4·0	97·0
3	Muriate of Potash ½cwt. + Superphosphate 2cwt. + Sulphate of Ammonia 2cwt. ...	43·0	54·0	3·0	98·0

In this series the potash addition to the superphosphate treatment has definitely increased the grass content and reduced the clover content, but the addition of potash to the superphosphate and 1 cwt. of ammonia had the reverse effect, the tendency being a slight decrease of the grass and an increase of the clover con-

tent. The addition of potash to the superphosphate and 2 cwt. of sulphate of ammonia treatment had no effect on the grass content but an increase of the clover at the expense of the bare ground.

The indications are that, should sulphate of ammonia be found profitable, additions of potash also may be necessary to counteract weed growth and prevent undue depression of the legumes in the pasture.

Tentative Advice.

1. For the time being, the practice of fertilising irrigated pastures with superphosphate alone should be continued until more information is available.

2. Applications of at least 2 cwt. superphosphate per acre per annum should be applied.

AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

Albany	A. C. Vaughan.
Bridgetown	A. Flintoff.
Bunbury	M. Cullity.
Denmark	V. L. Cardon.
Geraldton	G. L. Throssell (Government Buildings).
Gosnells	R. C. Owen.
Harvey	D. L. Breen (Fruit); C. Giles (Dairying).
Katanning	A. S. Wild
Kalamunda-Roleystone	W. H. Read, c/o. Department of Agriculture, Perth.
Manjimup	K. W. Simes.
Metropolitan, Gingin, Chittering ...	S. E. Bennett, c/o. Department of Agriculture, Perth.
Metropolitan to Spearwood ...	R. L. Cailes, c/o. Department of Agriculture, Perth.
Mundaring	V. Cahill.
Narrogin	H. R. Powell.
Northam	F. L. Shier.
Northcliffe	H. S. Rogers.
Vasse	J. M. Nelson.

SEEDING EXPERIMENTS WITH FIRST EARLY ("DWALGANUP") SUBTERRANEAN CLOVER.

By T. C. Dunne.

At the beginning of last season a short article* was published reviewing the information to hand concerning the establishment of First Early ("Dwalganup") Subterranean Clover. With a view to obtaining further information, experiments were conducted at Muresk during the past season. These are reported hereunder:—

DEPTH OF SEEDING.

A small trial was carried out to determine the effect of the depth of planting on the germination of subterranean clover.

The soil was that typical of jam country, being a sandy loam. This had been harrowed twice and consolidated by winter rains. The surface was firm and somewhat gritty.

The seed used was taken from a certified seed line grown on the College farm. No broken seeds were used.

One hundred seeds were placed on the surface of the soil at intervals of about six inches. Further lots of one hundred seeds were carefully sown at depths ranging from ¼ inch to 2 inches. Sowing was done on 28th May, 1935.

The rows were inspected after seven days and counts made of the number of plants showing.

Further counts were made at frequent intervals until forty days after sowing. No further plants appeared after this time.

The number of plants obtained from the various depths of sowing are given below.

Number of Plants from 100 Seeds.

Depth of Sowing.	Period after Sowing.							
	7 days.	10 days.	14 days.	17 days.	22 days.	27 days.	32 days.	40 days.
Surface	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
¼ inch	71	73	75	77	77	77	77	77
½ inch	59	63	72	73	73	75	75	75
1 inch	3	19	51	63	65	65	66	67
1½ inches ..	Nil	1	2	23	31	33	35	35
2 inches	Nil	Nil	Nil	1	1	2	2	2

An important feature of the results is the fact that no plants were obtained from seed sown on the surface of the ground. A number of the seeds germinated and produced root radicles, but these did not penetrate the soil and eventually died off.

Where seed is dropped on the surface of cultivated soils a certain amount of covering is obtained by the movement of soil particles by heavy rains. Nevertheless it is probable that a large proportion of the seed, even under these conditions, obtains no covering with consequent poor establishment.

The result is of more importance in relation to the establishment of clover on uncultivated paddocks. In such instances the surface is usually fairly hard so that few, if any, of the germinating seeds would obtain a root hold. Actually, almost total failures have been observed where clean seed was broadcast on the surface of bare uncultivated paddocks without any effort being made to give a light covering of soil.

*Dunne, T. C. First Early (Dwalganup) Subterranean Clover—Notes on Establishment. This Journal, Vol. XII. (2nd Series), Mar., 1935, pp. 81-84.

The best germinations were obtained with seeds sown at the ¼-inch and ½-inch depths. The germination at 1 inch was satisfactory, but the number of plants from deeper sowing showed a considerable decrease, and at 2 inches a failure resulted.

The time factor was very important. At ¼ inch most of the germination had occurred after seven days, whereas seventeen days elapsed before a reasonable number of plants appeared from the deeper sowing of 1 inch depth. The appearance of plants from the deeper sowings was considerably more delayed. In view of the necessity of waiting for reliable winter rains before sowing, this saving of time from shallow planting may have an important effect on establishment, particularly should the advent of winter rains be somewhat delayed.

The results confirm the recommendations made in the previous paper, viz., that the aim should be to plant at a depth of about ½ inch and that planting more deeply than 1 inch should be definitely avoided.

RATE OF SEEDING.

This trial was conducted in order to obtian further information concerning the most satisfactory rate of seeding for subterranean clover when sown with a cover crop.

The soil for the experiment was rather sandy. The area was ploughed and cultivated. A fair amount of rain fell between the time of cultivation and sowing so that a reasonably firm seed bed was procured.

Barley was used as a cover crop. This was sown through a disc drill on 31st May. The clover seed (Muresk Certified) was mixed with superphosphate and broadcasted on the surface on 6th June. Covering of the seed was obtained by using a brush harrow.

For the purpose of comparing the plots, analyses were made with a wooden square covering one square yard. This was dropped at random throughout the plots and readings made. At least twenty readings were obtained on each of the plots, which were each approximately one acre in extent.

The following readings were made:—

(a) *Actual Cover.*

An eye estimation of the percentage of the ground actually covered by clover.

(b) *Spread.*

An eye estimation of the percentage of the ground over which runners had spread thickly enough to give with normal seeding and germination a complete cover early the following year. This estimation was, of course, entirely arbitrary, but as establishment is dependent on spreading of the clover, it was felt that this constituted a satisfactory basis for comparison.

(c) *Number of plants per square yard.*

Owing to the entwining of the runners on the plots with the heavier seedings, accurate figures were impossible. Counts were therefore made only on the lighter seeded plots, these being of more practical interest.

The analyses were made on 16th October and 17th October.

The following are the results:—

	Clover Seed.	Cover. %	Spread. %	Plants per sq. yard.
Plot 1	2 lbs./ac.	18	55	9
Plot 2	4 lbs./ac.	35	89	16
Plot 3	8 lbs./ac.	58	97	—
Plot 4	4 lbs./ac.	34	88	18
Plot 5	16 lbs./ac.	84	100	—

Two plots of 4 lbs. per acre were included as controls to indicate any variability of soil or environment. While a discrepancy exists between the two plots as shown by the number of plants per square yard, the figures for "cover" and "spread" are remarkably close. In view of the large differences found between the different rates of seeding, there does not appear to have been present sufficient variability to seriously interfere with the results.

The figures under "cover" give a general idea of the thickness of the stand produced under each rate of seeding. Some indication of the bulk is obtained but it is only relative and of course none of the figures can be compared with an established pasture. As would be expected, there is an increase with each increase in the rate of seed sown. With the lighter rates this is roughly proportional to the seeding, but, as more seed is used, the increase is proportionately less. The figures demonstrate that even with a heavy sowing a really thick stand can hardly be obtained in the first year.

From the point of view of establishment of a good pasture the important figures are those under "spread." It will be observed that a big difference is found between the results from sowings of 2 lbs. per acre and 4 lbs. per acre, the former giving 55 per cent. spread and the latter 88 per cent. There is only a small additional increase obtained by raising the rate of seeding to 8 lbs. per acre, and a still small increase with 16 lbs. per acre sowing.

From the results obtained during the last season it appears to be uneconomic to seed heavier than 4 lbs. per acre. Under the conditions of the experiment is is considered that this latter was the most profitable amount sown. The 2 lb. per acre plot would eventually give good pasture, but the time saved with the heavier seeding should warrant the extra initial cost.

It should be noted, however, that the 1935 season was not very favourable owing to the lateness of the first reliable rains. It might occur, therefore, that a somewhat lighter rate of seeding than 4 lbs. per acre would be more economical under more normal conditions. For this reason it is intended that the experiment be repeated during the coming season. Nevertheless the present indications are that the most profitable rate of seeding will lie between 2 and 4 lbs. per acre.

SUMMARY AND CONCLUSIONS.

A depth of seeding trial was conducted with subterranean clover.

A lot of 100 clover seeds were dropped on the surface of the soil and further lots of 100 seeds were sown at depths ranging from ¼ inch to 2 inches. At frequent intervals counts were taken of the number of plants obtained from the various treatments. Best results were obtained with plantings of ¼ inch and ½ inch respectively, where 77 and 75 plants appeared from 100 seeds. Sowing at 1 inch was satisfactory, at 1½ inches the results were poor, and 2 inches sowing was a failure. No plants were obtained from seed dropped on the surface.

The results showed the need for shallow planting and the necessity for covering the seed.

A rate of seeding trial was conducted. Rates sown were 2, 4, 8, and 16 lbs. subterranean clover per acre.

Square yard analyses were made for purposes of comparison.

The results indicated that heavier sowings than 4 lbs. per acre would be unprofitable for pasture establishment. Under the conditions of the experiment 4 lbs. per acre appeared to be the most profitable rate of seeding.

AMENDMENTS TO REGULATIONS DEALING WITH FRESH FRUIT FOR EXPORT.

GEO. W. WICKENS,
Chief State Supervising Officer.

Whether it was due to the new colour grading regulations in force last season, or to the high quality of the fruit consequent on a heavy crop, or to more care taken by growers and packers in selecting and packing, or a combination of all three, the fact remains that Western Australian apples last year stood up to their old reputation of being, if not the best, then at least as good as the best, produced anywhere in the world. The crop this year is again a heavy one, the quality is again good and I feel certain after last season's success that growers and packers will not fall down on the job, and we may look forward confidently to receiving the same cheery reports from overseas markets.

In the amendments to the regulations this year the most noteworthy is the permission granted this year to ship large sized apples to any destination other than the United Kingdom, thus allowing 3in. Cleopatras, 3in. Sturmers, 3¼in. Dunns, and 3¼in. Granny Smiths to be exported to the Continent of Europe or any other markets than those of the United Kingdom: permission is also given to ship some of the less popular varieties to any destination other than United Kingdom and Europe.

A suggestion was made at the last Apple and Pear Council meeting that 2in. apples should be permitted to be exported to certain markets in India but this was refused and it will be noted in the list hereunder that the only 2in. apple to be passed for export to any destination is the Cox's Orange Pippin: the lowest size of any other variety being 2⅛in.

Some slight alterations have been made in the colour requirements—Extra Fancy, Dougherty being reduced from 50 per cent. to 40 per cent. and Extra Fancy Rokewood also from 50 per cent. to 40 per cent., while in both instances Fancy remains at 20 per cent.

The even colour stipulated in last season's regulations for green and yellow apples has been done away with: excepting for one variety, French Crab, which must be 70 per cent. green in the Extra Fancy grade.

The regulations still provide that the cases must be made from seasoned hardwood or softwood containing not more than 20 per cent. of moisture and that when the timber is either karri or jarrah the boards comprising the ends, tops and bottoms must be dressed on one side at least and the boards comprising the sides must be smoothly sawn or dressed.

The list of varieties of apples permitted to be exported, colour requirements, etc., are as shown hereunder, and it is provided that before seven of the varieties named in Part 1 are exported permission in writing of the Secretary, Department of Commerce, shall first be obtained. The seven referred to are:—Coleman, Jubilee, King Cole, McIntosh Red, Stayman, White Winter Pearmain, and Wellington.

7. The Third Schedule to the Commerce (General Exports) Regulations is repealed and the following Schedule inserted in its stead:—

THE THIRD SCHEDULE. Reg. 48.

VARIETIES, CLASSES, AND SIZES OF APPLES WHICH MAY BE EXPORTED, THE ABBREVIATED DESCRIPTION OF EACH VARIETY, THE MINIMUM PERCENTAGE OF COLOUR CHARACTERISTIC OF THE VARIETY NECESSARY ON EACH APPLE FOR EACH OF THE GRADES "EXTRA FANCY" and "FANCY."

PART I.—APPLES FOR EXPORT TO ANY DESTINATION.

Variety.	Abbreviated description.	Sizes (inches in diameter).	Percentage of Colour, characteristic of the variety, necessary on each apple in each grade.	
			Extra Fancy.	Fancy.
Alexander	ALX.	2½–3	30	10
Alfriston	ALF.	2½–3½	...	...
Aromatic	ARO.	2¼–2¾	50	20
Australian Beauty	A.B.	2¼–2¾	50	20
Cloepatra	CLEO.	2¼–2¾	...	...
Coleman	CMN.	2¼–2¾	50	20
Cox's Orange Pippin	C.O.P.	2–2¾	30	5
Crofton	CROF.	2½–2¾	50	20
Crow Egg	C.E.	2½–3	30	10
Delicious	DEL.	2¼–2¾	50	20
Democrat	DEM.	2¼–3¼	70	35
Dougherty	DHTY.	2¼–2¾	40	20
Duke of Clarence	D.C.	2¼–3	70	35
Dunns	DUNNS	2¼–3	...	...
French Crab	F.C.	2⅜–3	70 (green colour)	...
Geeveston Fanny	G.F.	2¼–2¾	50	20
Granny Smith	G.S.	2½–3	...	...
Jonathan	JON.	2½–2¾	50	20
Jubilee	JUB.	2¼–2¾	50	20
King Cole	K.C.	2¼–2¾	50	20
King David	K.D.	2½–2¾	70	35
King Pippin	K.P.	2½–2¾	30	10
London Pippin	L.P.	2½–3	...	...
McIntosh Red	McINTOSH RED	2¼–2¾	70	35
Mobbs Codlin	M.C.	2½–3	...	...
Newtown Pippin	N.T.P.	2½–2¾	...	...
Nickajack	NJ.	2½–3	30	10
Pomme de Neige	P.D.N.	2½–2¾	30	10
Prince Alfred	P.A.	2½–3¼	30	10
Reinette du Canada	R.D.C.	2½–3	...	...
Ribston Pippin	R.P.	2½–2¾	...	...
Rokewood	ROKE	2½–2¾	40	20
Rome Beauty	R.B.	2½–3	30	10
Scarlet	S.P.M.	2½–2¾	50	20
Schroeder	SCH.	2½–3	...	...
Statesman	STN.	2½–2¾	30	10
Stayman	STAY.	2½–2¾	30	10
Stewarts	SS.	2½–3	...	...
Stone Pippin	S.P.	2½–3	...	...
Sturmer	S.T.P.	2½–2¾	...	...
Tasman's Pride	T.P.	2½–3	50	20
Wellington	WTN.	2½–3	...	...
White Winter Pearmain	W.W.P.	2½–2¾	...	...
Worcester Pearmain	W.P.M.	2½–2¾	50	20
Yates	YATES	2½–2¾	50	20

PART II.—APPLES FOR EXPORT TO ANY DESTINATION OTHER THAN THE UNITED KINGDOM OR A DESTINATION REACHED BY WAY OF THE UNITED KINGDOM.

Variety.	Abbreviated description.	Sizes (inches in diameter).	Percentage of colour, characteristic of the variety, necessary on each apple in each grade.	
			Extra Fancy.	Fancy.
Cleopatra	CLEO.	2¼–3	...	...
Dunns	DUNNS	2¼–3¼	...	...
Granny Smith	G.S.	2¼–3¼	...	...
Sturmer	S.T.P.	2¼–3	...	...

PART III.—APPLES FOR EXPORT TO ANY DESTINATION OTHER THAN THE UNITED KINGDOM OR THE CONTINENT OF EUROPE.

Variety.	Abbreviated description.	Sizes (inches in diameter).	Percentage of Colour, characteristic of the variety, necessary on each apple in each grade.	
			Extra Fancy.	Fancy.
Gravenstein	GRAV.	2¼–2¾	...	...
McIntosh Red	McINTOSH RED	2¼–3	70	35
Pioneer	PIONEER ...	2¼–3	...	...
Nickajack	NJ.	2¼–3¼	30	10
Rymer	RYM.	2¼–2¾	25	10
Spitzenberg	SPTZ.	2¼–2¾	40	15
Stayman	STAY.	2¼–3	30	10

THE IMPORTANCE OF FEEDING FOR LAMB PRODUCTION.

HUGH McCALLUM,

Sheep and Wool Inspector.

It was evident after inspecting several consignments at the Midland fat stock sale yards and on the farms, that there is a factor, essential to high prices, which is not receiving sufficient attention at the hands of many farmers; that is, the condition of each lamb in a consignment. Lambs are being put on the market in anything but prime condition, with consequent lowering of prices.

Every lamb dropped at a certain time may not develop at the same rate as the major portion of the drop, therefore the slower maturing animals should be held back: undersized and poor conditioned lambs will sell at low prices. When forwarding lambs to market select the best: a week or two of feeding the slower maturing lambs will mean an advance in price when in market condition.

Export lambs cannot be bred unless suitable and abundant feed is provided; the ewes must be well maintained on grass, and other succulent feed: fodders must be sown for this purpose. We cannot breed export lambs on natural pastures. From poorly fed ewes good lambs cannot be expected, they are starved before they

are dropped. They have not the constitution and do not thrive, when compared with lambs that are well fed from birth and never receive a setback. Leave nothing to chance in export lamb breeding. Farmers must have reserves of feed. They will be wise to study, not only the immediate requirements, but the future, and plan out the scheme of cropping, so that suitable feed will be available at the right time. Export lamb raising can only be made a payable proposition if attention is paid to correct breeding, mating and feeding.

Any check due to a shortage of feed means a decrease in the milk supply from the mother, and a setback to the lamb; therefore, the value of feeding is very important. An uneven system of feeding cannot be tolerated in Western Australia if we wish to retain the State's good name for export lambs. Much has been done regarding pastures, yet much remains to be done regarding the correct type of ewes to produce the lambs required by the British public.

CRUTCHING SHEEP.

Hugh McCallum, Sheep nd Wool Inspector.

One of the most efficient methods of combating the blowfly is to ensure good crutching. The discoloration about the hind-uarters is due to accumulation of dirt in the long wool. This should be removed by crutching as it acts as an ideal breeding ground for the blowfly.

Crutching should be done as often as is necessary, especially in wrinkly ewes, but in very wet weather other precautions must be taken. A systematic mass crutching should be aimed at instead of dealing with an odd sheep here and there in the paddock, as is often the practice.

The actual operation should be started by clearing the wool from behind the udder and between the hind legs. This section is done with the sheep sitting on its haunches and having its back leaning against the closed legs of the shearer. For the next part the sheep must be laid on one side and the wool removed from the back of the lower leg and just beneath the tail. The sheep is then turned on the other side, and the opposite back leg treated likewise. It is advisable to take off a narrow strip of wool from just above the tail. The finished job looked at from behind takes the form of an inverted "U" running from hock to hock over the tail. It is wise to slope off the wool between the short and long parts, and not leave a distinct ridge of over-hanging wool to get wet and dirty, and so attract more flies.

Great care should be taken of pregnant ewes, which should on no account be carried from the pen. It is advisable to take the utmost care of them when going through gateways, and when turning them. When crutching there is no necessity to lean on the sheep with the knee or to press heavily on the flank with the fist. The ultimate results of handling ewes roughly are premature birth, malformations, and dead lambs.

Many flock owners crutch their high-grade ewes in a standing position, one person holding the sheep and another handling the shears. By this method there is no possibility of the lamb being turned. The standing position may be much slower, but it is certainly the safest method under these circumstances.

Another benefit derived from crutching is the saving of wool. Through neglect of crutching sheep regularly and correctly a considerable poundage of good wool is wasted at shearing time on account of the large percentage which is stained.

Briefly, then, crutching helps against blowfly, saves wool, and though not previously mentioned, is an assistance in lambing and lamb-feeding.

THE VALUE OF NITROGENOUS FERTILISERS FOR WHEAT IN WESTERN AUSTRALIA.

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The dependence of the world on its nitrogen supplies for food production has been recognised for half a century and realisation of this prompted Sir William Crookes in 1898 to forecast a food shortage in the present decade (1930-1940) assuming the rate of increase of population was maintained and that no new source of nitrogen was obtained.

Fortunately there is no danger of a food shortage in sight—the problem was solved by the discovery of new agricultural lands, the use of improved methods of farming, and the commercialisation of the electric process of nitrogen fixation. The first two factors have played a very important part in Western Australia, and the question to be answered is "Can nitrogenous fertilisers be used profitably for wheat?"

There is abundant evidence in the literature of the value of nitrogenous fertilisers for many crops under a wide range of environmental conditions. Probably the most marked responses have been obtained with the more intensively farmed crops and pastures. However, a number of investigations have shown payable responses with cereals in Australia, particularly when sown on stubble land (land which has not lain as fallow for several months) in the higher rainfall districts. Richardson & Gurney (1933), Wark (1934). It is most probable that similar responses would be obtained under similar environmental conditions in Western Australia.

With wheat, two types of response may be looked for—

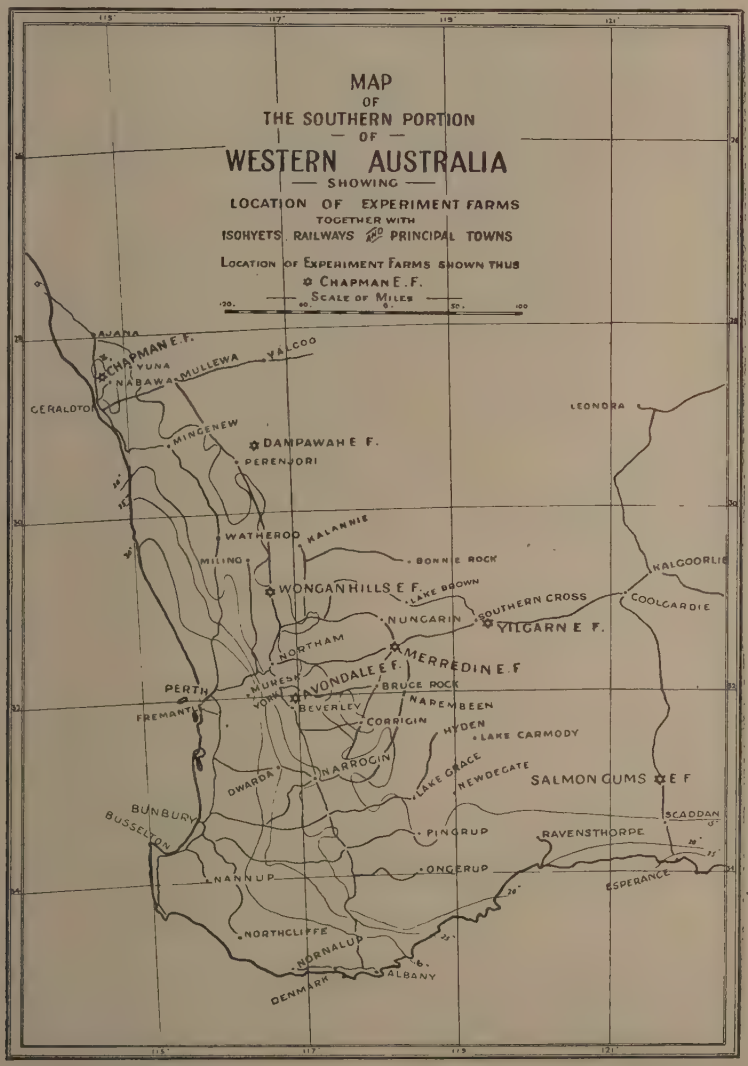
(a) an increase in yield;
(b) an increase in protein content of the grain.

A number of authors have reported results bearing on these responses, and there is a body of information which indicates that—

(a) Under certain conditions wheat will respond with an increased yield when nitrogenous fertilisers are applied at seeding or at an early stage of growth.
(b) Under other conditions the yield is not affected, or there may be even a slight decrease in yield.
(c) When nitrogenous fertilisers are applied toward the end of the growing season certain groups of wheat varieties yield no better than untreated controls, but the grain is of a higher nitrogen content. Other groups of varieties show no response.
(d) When nitrogenous fertilisers are applied at seeding or early in the growing season in some cases a decrease in the nitrogen content of the grain has been recorded. Gericke (1927) ascribed this to the increased vigour of the early growth resulting in a nitrogen deficiency at the time of maturation.

In order to obtain reliable information concerning the effect of nitrogenous fertilisers on the yield of wheat and the composition of the grain under the conditions of the Wheat Belt of Western Australia, the Wheat Branch of the Department of Agriculture conducted a series of experiments with sulphate of ammonia as a supplement to the usual superphosphate dressing. The experiments were conducted over a period of three years (1929, 1930 and 1931) at the seven State Experiment

Farms located at Merredin, Nabawa (Chapman), Wongan Hills, Dampawah, Ghooli (Yilgarn), Beverley (Avondale*) and Salmon Gums, and the results have been recorded by Thomas and his staff (1930 a, b, c, d, e, f, g; 1931 a, b, c, d, e, f; 1932 a, b, c, d, e, f). These experiment farms are representative of the principal soils and climatic conditions of the Western Australian Wheat Belt, and the results can be taken as a basis for recommendations in this belt. The location of these ex-



periment farms may be seen from the map. It will be apparent that they are well distributed geographically throughout the Wheat Belt. Further, on them are represented the principal soils of the Wheat Belt, namely the brown earth soil zone, the mallee soil zone, the fringe of the so-called desert steppe soil zone (Dampawah) and the lateritic soils (Wongan Hills) as delineated by Prescott (1931). The

* The experiments at Avondale Experiment Farm ran for one year only.

climatic range is indicated by the meteorological information in Table 1. The information in this table is obtained from C.S.I.R. (Australia) Pamphlet 42 (1933) and from the Commonwealth Meteorologist.

TABLE 1.

METEOROLOGICAL CONDITIONS OF THE WHEAT BELT OF WESTERN AUSTRALIA, REPRESENTED BY THE EXPERIMENT FARMS OR CONTIGUOUS CENTRES.

(Information from Pamphlet 42, C.S.I.R. (Aust.), "Meteorological data for certain Australian Localities.")

Centre.	——	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Annual.	Soil Zone.*
Chapman	Temperature Mean (°F) ...	78·2	78·0	75·0	70·2	62·4	57·7	55·6	56·2	59·5	62·4	70·0	74·6	66·6	Brown earth.
	Rainfall (points)	27	48	65	44	234	438	399	263	162	96	29	22	1827	
Geraldton (represents Chapman) ...	Temperature Mean (°F) ...	75·0	75·6	73·8	70·2	65·1	61·6	59·5	60·2	61·9	64·2	68·2	72·2	67·2	Brown earth.
	Rainfall (points)	22	30	45	83	281	485	390	285	136	71	26	16	1870	
	Meyer Ratio P : s.d.† ...	6·6	9·2	15	31	150	340	310	200	82	34	10	5·5	69·3	
York (represents Avondale)	Temperature Mean (°F) ...	76·3	76·0	71·6	65·2	57·7	53·4	51·6	52·8	55·9	59·8	67·8	73·6	63·4	Brown earth.
	Rainfall (points) ...	31	45	65	81	228	337	342	279	160	103	43	41	1755	
	Meyer Ratio P : s.d.† ...	8·1	13	24	46	270	680	800	420	150	62	16	11	87·8	
Watheroo	Temperature Mean (°F) ...	76·2	76·3	72·8	66·4	58·3	53·8	51·6	52·8	56·6	59·8	68·0	73·0	63·8	Laterite (Mallee)
	Rainfall (points)	41	58	70	71	232	368	326	222	158	87	32	36	1701	
	Meyer Ratio P : s.d.† ...	8·6	13	20	28	190	490	490	240	110	42	9·6	8·6	65·4	
Merredin	Temperature Mean (°F) ...	77·2	76·4	71·7	64·4	56·6	52·1	50·0	51·0	55·4	60·2	68·5	73·8	63·1	Mallee.
	Rainfall (points)	41	50	110	90	158	209	221	143	114	84	44	60	1324	
	Meyer Ratio P : s.d.† ...	11	15	51	64	210	460	620	340	120	50	15	16	71·5	
Southern Cross (represents Yilgarn) ...	Temperature Mean (°F) ...	78·3	77·4	72·4	65·3	57·0	52·4	50·3	52·6	57·4	62·6	71·1	76·2	64·4	Mallee.
	Rainfall (points)	49	62	106	77	143	142	143	108	78	59	49	52	1068	
	Meyer Ratio P : s.d.† ...	11	16	36	38	130	220	260	130	52	27	15	12	45·4	
Yalgoo	Temperature Mean (°F) ...	83·6	82·6	78·2	71·0	61·4	55·8	53·8	55·8	61·2	66·4	74·9	80·8	68·8	
	Rainfall (points)	62	92	107	53	133	186	132	105	51	35	23	38	1017	
	Meyer Ratio P : s.d.† ...	11	18	27	19	89	220	180	97	28	13	5·6	7·1	33·9	Desert steppe.

* Prescott (1931). † Figures for Meyer Ratio by months calculated by multiplying the monthly precipitation by 12 and dividing by the saturation deficit for the month.

THE EXPERIMENTS.

The series of experiments was designed to show—

(a) Whether increased yield of wheat grain would be obtained by the use of sulphate of ammonia at various times during the growing period.

(b) Whether these treatments would affect the nitrogen content of the grain.

The experiments were conducted on a field scale, using plots of about ⅛ acre in area arranged on the standard three-plot system adopted in this Department for experiment and demonstration purposes.* Each experiment consists of three treatments in quintuplicate and any systematic soil variations may be detected by examination of the plot yields. Although the arrangement of the plots is systematic, it is claimed that a reasonably valid estimate of standard error is possible in most cases.

The following treatments with nitrogenous fertiliser on wheat grown on both fallowed land, and on grass land† ploughed just prior to seeding were arranged:—

1. 1 cwt. sulphate of ammonia per acre at seeding (May).
2. 2 cwt. sulphate of ammonia per acre at seeding.
3. ½ cwt. sulphate of ammonia per acre at seeding, plus ½ cwt. sulphate of ammonia per acre in August.
4. 1 cwt. sulphate of ammonia per acre at seeding, plus 1 cwt. sulphate of ammonia per acre in August.

All plots received a basal dressing ranging from 90 to 150 pounds of superphosphate (22% P_2O_5) per acre and were compared with control plots receiving the basal dressing only. August was selected as the most convenient time for the second dressing of sulphate of ammonia as, in normal seasons, the wheat is just beginning to run up to ear at this time. The grain from each plot was harvested with a "stripper-harvester" and weighed in the field. At the time of weighing, a sample of the wheat from each plot was taken for the determination of total nitrogen in the Government Chemical Laboratory. The Kjeldahl method was used throughout and the results were calculated to the moisture free basis.

RESULTS OF THE EXPERIMENTS.

The details of the plot yields have been published by Thomas and his associates (loc. cit.) and in this paper only a summary of these details is reported. The statistical significance of the treatment differences has been determined by means of the "z" test.

The results of the experiments are shown in Tables 2-8, giving the yield and nitrogen content of the grain together with the rainfall recorded during the experiments.

DISCUSSION OF DATA.

A. *Climatic.*

The range of the mean annual precipitation recorded is from about 10.5 inches to 19 inches, and most of this falls during the "winter" months, the so-called "growing period" (May to October), when temperatures are mild and the relative

* It must be noted that in the first year of the experiment (1929) it was necessary to modify this arrangement somewhat and to use plots 1/16 acre in area. This would not interfere with the accuracy of the experiment.

† Under the 3-year rotation practised on these farms the land was allowed to lie under grass between crops. In these experiments the non-fallow land consisted of this grass land ploughed up just prior to seeding.

humidity high. The Meyer ratios,* calculated on a monthly basis, show that the climate is cool and humid during these winter months, but desertic during the remainder of the year. The "growing period" is thus succeeded by a very hot, dry ripening period.

The data available for Geraldton, York, Watheroo and Merredin show that the temperature conditions and the Meyer ratios are of similar order of magnitude throughout the wheat belt. Southern Cross, on the eastern fringe, is definitely more arid climatically and approaches the conditions at Yalgoo, which is beyond the fringe of the wheat belt. No doubt, Dampawah would be found to compare with Southern Cross if the data were available.

The chief climatic factor in the wheat belt of Western Australia is, therefore, considered to be the rainfall, and this, when combined with the rapid incidence of desertic conditions in October and November, must govern the types of wheat suitable and must affect the growth of the wheat and the composition of the grain.

B. *The effect of Sulphate of Ammonia as a fertiliser on the yield of wheat and the nitrogen content of the grain.*

The results of these experiments show that, under present conditions, nitrogenous fertilisers are not likely to improve the yield or the nitrogen content of wheat grain on forest land of the types occurring at Merredin and Yilgarn of the mallee zone of the wheat belt. No statistically significant increases in yield were obtained on fallowed land or non-fallowed land at Merredin and Yilgarn or at Salmon Gums, and at Salmon Gums the nitrogen content of the grain was increased by the use of nitrogenous fertiliser only in one year (1930), when an increase of 0.2 per cent. of nitrogen above the control was recorded from the plot receiving 2 cwts. of sulphate of ammonia. This observation cannot be regarded as very conclusive

At the Dampawah Experiment Farm a significant depression in yield resulted from the use of sulphate of ammonia in 1930 and 1931, years of low yield. It is probable that the nitrogen applications stimulated early vegetative growth which could not be sustained during maturation under the conditions prevailing. In 1929, a high yield season, no significant effect was observed. In no instance was the nitrogen content of the grain affected by the fertiliser treatments.

At the Wongan Hills Experiment Farm, significant responses in the shape of increased yields were generally, although not invariably, obtained. The only year not recording an increase in yield was 1930, on the non-fallow plots. The control yields were high and apparently some factor other than nitrogen proved limiting. Increases of from 3 to 8 bushels of wheat were obtained in other years. The nitrogen content of the grain generally showed no response or only a slight, if significant, increase (0.1 to 0.4 per cent.) as a result of the treatment with nitrogenous fertiliser. The time of application appeared of little importance.

At the Chapman Experiment Farm significant increases in yield were obtained from certain treatments on non-fallow in 1929 and 1930, but a depression was recorded in 1931 on fallow. These results are not considered very conclusive. Of eight sets of plots in the course of the three years, in five sets the nitrogen content of the grain was significantly raised by the nitrogenous fertiliser; in one set a decrease was recorded and no response was observed in the other two sets.

As the experiment was carried out for one year only at Avondale, the data is incomplete and, although one instance of a statistically significant increase in both yield and nitrogen content of the grain was observed as a result of the nitrogenous fertiliser the evidence is regarded as inconclusive.

* The Meyer ratio is obtained by dividing the annual precipitation by the mean annual saturation deficit of the atmosphere with respect to water vapour and is found to be a valuable index of climatic conditions.

It may be concluded that nitrogen is a limiting factor with respect to yield on "lateritic" soils of low fertility. In the brown earth zone there is only a small chance for any considerable response in yield and nitrogen content of the grain from the use of nitrogenous fertilisers for wheat.

C. *Factors affecting the yield and nitrogen content of grain.*

Wheat Yields. The principal factors affecting wheat yields on the experiment farms are rainfall and soil conditions. At the Merredin, Yilgarn and Dampawah Experiment Farms, the soil conditions are most satisfactory and the rainfall is generally the limiting factor. The papers by Teakle (1929), and by Teakle and Burvill (1930 a, 1930 b) show that the soils of Merredin and Yilgarn (Ghooli), particularly Merredin, are quite rich with respect to nitrate. The conditions at Wongan Hills, Chapman and Avondale are less satisfactory and soil fertility factors and physical properties are probably limiting. At Salmon Gums both soil and climatic factors probably contribute to the low yields. No attempt has yet been made to correlate wheat yields in Western Australia with rainfall and its incidence and with soil conditions.

In the comparison of the yields, it is apparent that the fallow land generally yields higher than the non-fallow at all farms. Furthermore, the response to nitrogen fertilisation, where it occurs, is not consistently greater on non-fallow than on fallow, supporting the conclusion of Teakle and Burvill (1930 a) that the benefit of fallow is the resultant of the interaction of a number of factors rather than of a single one such as nitrogen.

Nitrogen content of the wheat grain.—A study of the nitrogen content of the grain at the several centres reveals seasonal variations in the nitrogen content, variations correlated with cultural treatments at each farm and a very considerable difference between the different farms. This is illustrated in fig. 1.

Seasonal variations are illustrated by Merredin where in 1929, a year characterised by a very dry period in August, September and October, the grain was of higher nitrogen content than in the other years. The season 1930 is generally characterised by low nitrogen grain at Chapman, Salmon Gums and Wongan Hills, although the factors responsible are not apparent. No seasonal variation is noted at Yilgarn and Dampawah. It is postulated that the limiting climatic conditions render nitrogen absorption a maximum and the nitrogen accumulation in the grain reaches a maximum percentage amounting to 2.9 to 3.1 per cent. This maximum percentage is also approximated at Merredin on occasions.

That the cultural treatment is effective is illustrated by the comparison of data for fallow and non-fallow in the tables and illustrated in fig. 1. Grain from non-fallow plots is consistently lower in nitrogen at Merredin, Salmon Gums, Chapman and Avondale.

At Yilgarn and Wongan Hills, the cultural treatment has had no apparent effect, while the non-fallow plots at Dampawah have yielded grain of higher nitrogen content. It is suggested that compensating limiting factors are responsible for these variations in response. At Dampawah the soil moisture factor on non-fallow may be dominant in its effect on the nitrogen content of the grain, whereas at Yilgarn and Wongan Hills the similar nitrogen content of the grain under both cultural treatments may be the resultant of the interaction of a number of factors. That the factor is not simply nitrogen is shown by the lack of response or small response to nitrogen as a fertiliser.

The most outstanding differences obtained were between the nitrogen contents of the grain from the different farms. From fig. 1 it will be seen that the farms fall into two groups—

a. grain above 2.5 per cent. nitrogen (Dampawah, Yilgarn, Merredin);
b. grain below 2.5 per cent. nitrogen (Salmon Gums, Chapman, Avondale, Wongan Hills).

Although there is some relationship (inverse) between the growing period rainfall and this grouping of the farms, it is apparent that some other factor is also effective. From the rainfall data it would be expected that the grain from

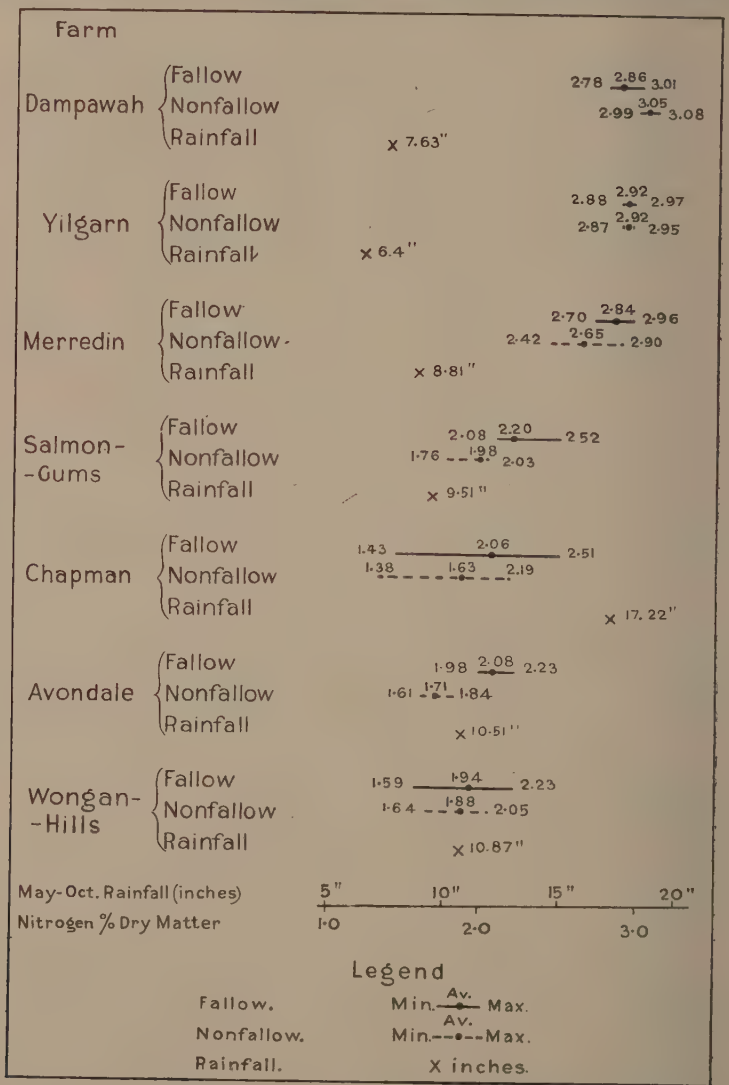


Fig 1.—Diagrammatic representation of the range of nitrogen contents of wheat grain at the Experiment Farms from the experiments described, and the average "growing period" (May to October) rainfall during these seasons.

Salmon Gums, Avondale and Wongan Hills would show a higher nitrogen content. It is suggested that the soil factor may be an important influence in this respect. The soils of Wongan Hills are sands of low inherent fertility; the soils of Chap-

man generally are light textured sandy loams of medium fertility and the Salmon Gums soils are sands with a solonised sandy clay subsoil of no more than medium fertility. The Avondale soils are generally of medium to fair fertility. The Dampawah soil is a red loamy sand to sandy loam of no more than medium fertility. By contrast, the soils of Merredin and Yilgarn are rich forest soils.

It seems more than a coincidence that the lighter soils should yield a lower nitrogen grain than the heavier soils. It is interesting to note that Eva and Birchard (1933) also bring in the soil factor to explain differences of nitrogen content of wheat grain from the North American prairies. Here, too, the climatic factor is not apparently adequate to account for all the differences observed. It will be recognised that the segregation of the various soil factors is a problem of considerable difficulty.

The part played by the soil factor in Western Australia in connection with the nitrogen content of wheat grain and related properties such as baking quality is receiving further attention but data are not yet available for discussion.

It will be observed that two varieties of wheat have been used in these experiments—"Gluyas Early" in the drier districts, and "Nabawa" in the wetter districts. Several analyses of the grain of these two varieties, grown under the same conditions, show them to have almost identical nitrogen contents, viz., "Nabawa," average nitrogen content 2.12 per cent., "Gluyas Early," 2.15 per cent., and thus, for the purposes of this comparison they may be regarded as the same.

SUMMARY AND CONCLUSIONS.

A series of experiments with wheat on fallow and non-fallow were conducted over a period of three years at the seven experiment farms throughout the wheat belt of Western Australia to determine the effect of dressings of sulphate of ammonia applied—

a. at seeding;

b. half dressing at seeding and half dressing in August;

on the yield and nitrogen content of grain.

The results have been summarised and discussed in the light of climatic and soil conditions.

It is concluded that nitrogenous fertilisers for wheat grain production, either on fallow or non-fallow land (grass land ploughed up just prior to seeding) are not likely to give significant increases of yield in the Western Australian wheat belt except under the conditions represented by the Wongan Hills light land soils which are described as "lateritic." The effect on the yield under the low rainfall conditions at Dampawah is likely to be a depression except in high yielding seasons.

As regards the nitrogen content of the grain, significant increases were recorded but are of such small magnitude, generally equivalent to not more than 0.2 per cent. nitrogen, as to be of small importance.

The most important difference observed is the district effect on the nitrogen content of the grain. While there is an inverse relationship between per cent. nitrogen and growing period rainfall, the climatic factor does not appear adequate to account for the differences observed.

It is suggested that the soil conditions exert an important supplementary influence to the climatic factor.

ACKNOWLEDGMENTS.

The authors wish to acknowledge the work of officers of the Wheat Branch who carried out the field work in connection with the investigation, of officers of the Government Chemical Laboratory who made the analyses for nitrogen content of the grain, and of the Chief Draughtsman of the Lands Department, who prepared the map and the sketch for Fig. 1.

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1932 (d) Merredin Experiment Farm. Ibid. 9, 83.
1932 (e) Wongan Hills Light Lands Farm. Ibid. 9, 91-92.
1932 (f) Salmon Gums Experiment Farm. Ibid. 9, 200.

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1934. An investigation into the influence of Sulphate of Ammonia on stubble sown oat crop in Victoria. Proc. Roy. Soc. (Vict.) 47 (New series) 78-95.

TABLE 2.

Effect of Sulphate of Ammonia as a fertiliser for wheat for grain—
(*a*) On yield of grain.
(*b*) On nitrogen content of the grain.

MERREDIN EXPERIMENT FARM.

Superphosphate—All plots received a basal dressing of 112–150 lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	None (Control).	½ cwt. Seeding, ½ cwt. August.	1 cwt. Seeding, 1 cwt. August.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow ...	1929	Gluyas Early ...	18 57	18 58	18 43	17 58	18 56	18 12	...	...	...	...	...	...	Not significant.
	1930	Do. ...	...	...	...	...	...	...	28 8	28 40	29 12	28 37	29 1	29 34	do.
	1931	Do. ...	21 9	21 47	21 6	21 9	21 34	21 44	...	...	...	...	...	...	do.
Non-fallow ...	1929	Do. ...	15 4	13 31	15 45	15 46	15 28	16 30	...	...	...	...	...	...	do.
	1930	Do. ...	...	...	...	...	...	...	28 19	29 57	29 41	29 10	29 7	29 44	do.
	1931	Do. ...	16 19	16 19	16 24	17 14	16 38	17 6	...	...	...	...	...	...	do.
			NITROGEN CONTENT PER CENT OF DRY MATTER.												
Fallow ...	1929	Gluyas Early ...	2·91	2·92	2·96	2·92	2·86	2·92	...	...	...	...	...	...	Not significant.
	1930	... ...	...	...	...	...	...	...	...	...	...	...	...	...	
	1931	Gluyas Early ...	2·78	2·78	2·81	2·70	2·78	2·79	...	...	...	...	...	...	do.
Non fallow ...	1929	Do. ...	2·81	2·84	2·83	2·86	2·90	2·86	...	...	...	...	...	...	do.
	1930	Do. ...	...	...	...	...	...	...	2·42	2·44	2·44	2·57	2·63	2·69	do.
	1931	Do. ...	2·42	2·49	2·48	2·73	2·65	2·67	...	...	...	...	...	...	do.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Conventional Growing Period. Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Total, May-Oct.	Nov.	Dec.	Annual Total.
1929	50	162	77	...	357	309	119	94	13	35	927	220	5	1,441
1930	...	1	281	186	40	363	137	184	65	34	823	1	41	1,333
1931	...	54	4	191	218	115	197	257	81	44	912	24	40	1,225
Average. 1912–1935 ...	50	50	110	96	130	182	189	154	86	85	826	42	51	1,224

TABLE 3.

Effect of Sulphate of Ammonia as a fertiliser for wheat grain—

(a) on yield of grain;
(b) on nitrogen content of the grain.

SALMON GUMS EXPERIMENT FARM.

Superphosphate.—All plots received a basal dressing of 112-120 lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow	1929	Nabawa	13 31	13 21	12 18	13 20	12 11	13 24	...	...	...	Not significant.
	1930	Do.	...	...	...	...	...	...	14 56	13 42	13 23	do.
	1931	Do.	...	...	...	...	...	...	11 26	12 5	11 25	do.
Non-fallow ...	1930	Nabawa	...	...	...	...	...	...	12 42	12 2	12 19	do.
	1931	Do.	...	...	...	...	...	...	10 5	9 46	10 6	do.
			Nitrogen Content per cent of Dry Matter.									
Fallow	1930	Nabawa	...	...	...	...	...	...	1·87	1·86	1·96	Not significant.
	1931	Do.	...	...	...	...	...	...	2·12	1·99	2·10	do.
Non-fallow ...	1930	Do.	...	...	...	...	...	...	1·76	1·84	1·97	Significant.
	1931	Do.	...	...	...	...	...	...	2·13	2·08	2·08	Not significant.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Conventional Growing Period. Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
1929	106	65	73	26	125	207	159	163	21	35	710	150	43	1,173
1930	...	...	312	162	269	156	92	230	73	17	837	14	298	1,623
1931	...	179	2	74	246	232	175	408	81	163	1,305	98	11	1,669
Average, 1926-1935	46	58	146	106	119	132	153	188	88	121	790	86	54	1,285

TABLE 4.

Effect of Suphate of Ammonia as a fertiliser for wheat for grain—
(a) on yield of grain ;
(b) on nitrogen content of the grain.

YILGARN EXPERIMENT FARM.

Superphosphate—all plots received a basal dressing of 112-120 lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow	1929	Gluyas Early ...	7 57	8 13	6 17	7 33	7 40	7 0	...	...	...	Not significant.
	1930	Do. ...	...	...	...	...	...	...	17 14	18 11	17 49	do.
	1931	Do. ...	...	...	...	...	...	...	15 13	16 27	16 46	do.
Non-fallow ...	1930	Do. ...	...	...	...	...	...	...	13 2	12 42	11 52	do.
	1931	Do. ...	...	...	...	...	...	...	8 24	8 11	9 26	do.
			Nitrogen Content per cent. of Dry Matter.									
Fallow	1929	Gluyas Early ...	2 97	2 94	2 94	2·88	2·94	2·92	...	...	...	Not significant.
	1930	Do. ...	...	...	...	...	...	...	2·88	2·91	2·86	do.
Non-fallow ...	1930	Do. ...	...	...	...	...	...	...	2·95	2·87	2·95	do.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Jan.	Feb.	Mar.	Apl.	Conventional Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
1929	36	120	50	...	275	145	57	25	9	60	571	294	...	1,071
1930	...	167	62	209	87	229	88	110	45	9	568	10	173	1,189
1931	3	19	8	97	285	131	106	180	83	19	804	80	8	1,019
Average, 1928-1935	50	50	72	119	159	140	125	161	50	83	717	56	45	1,108

TABLE 5.

Effect of sulphate of ammonia as a fertiliser for wheat for grain—
(a) on yield of grain ;
(b) on nitrogen content of the grain (dry basis).

DAMPAWAH EXPERIMENT FARM.

Superphosphate—All plots received a basal dressing of 120 lbs. per acre.

		Treatment with Sulphate of Ammonia.		Average Yield per Acre.									
				None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	Statistical Significance.
	Year.	Variety.		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow	1929	Gluyas Early	...	19 29	19 0	19 9	19 51	19 58	19 58	...	...	...	Not significant.
	1930	Do.	...	...	...	...	...	...	...	7 58	7 17	5 52	Significant.
	1931	Do.	...	...	...	...	...	...	...	10 32	8 53	8 43	do.
Non-fallow ...	1930	Do.	...	...	...	...	...	...	...	7 18	6 10	5 7	do.
	1931	Do.	...	...	...	...	...	...	...	7 50	6 27	5 44	do.
				Nitrogen Content per cent. of Dry Matter.									
Fallow	1929	Gluyas Early	...	2·78	2·83	2·79	2·77	2·82	2·83	...	...	...	Not significant.
	1930	Do.	...	...	...	...	...	...	...	2·94	2·96	3·01	do.
Non-fallow ...	1930	Do.	...	...	...	...	...	...	...	2·99	3·07	3·08	do.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Jan.	Feb.	Mar.	Apl.	Conventional Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
1929	17	220	64	...	267	234	60	62	18	33	674	120	...	1,095
1930	...	...	93	123	48	404	160	93	22	41	768	31	54	1,069
1931	...	12	3	25	237	113	232	95	131	40	848	179	120	1,187
Average, 1929-1935	42	57	130	77	163	225	164	172	56	45	826	65	42	1,240

TABLE 6.

Effect of Sulphate of Ammonia as a fertiliser for wheat for grain—
(*a*) On yield of grain.
(*b*) On nitrogen content of the grain.

WONGAN HILLS EXPERIMENT FARM.

Superphosphate—All plots received a basal dressing of 120–150lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	½ cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	None (Control).	½ cwt. Seeding, ½ cwt. August.	1 cwt. Seeding, 1 cwt. August.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow ...	1929	Nabawa ...	6 5	11 4	8 12	6 34	12 11	11 1	...	...	...	...	...	...	Significant.
	1930	Do. ...	...	...	...	...	...	...	15 55	21 6	22 11	16 26	20 26	21 31	do.
	1931	Do. ...	...	...	...	...	...	...	20 38	22 58	20 38	18 27	25 54	25 58	do.
Non-fallow ...	1929	Gluyas Early ...	9 48	12 28	12 3	9 23	14 37	12 43	...	...	...	...	...	...	do.
	1930	Nabawa ...	...	...	...	...	...	...	17 38	17 34	16 16	16 43	17 42	17 4	Not significant.
	1931	Gluyas Early ...	...	...	...	...	...	...	14 27	19 33	23 22	14 24	17 55	22 27	Significant.

NITROGEN CONTENT PER CENT. OF DRY MATTER.

Fallow ...	1929	Nabawa ...	2·21	2·07	2·18	2·20	2·22	2·23	...	...	...	...	...	...	Not significant.
	1930	Do. ...	...	...	...	...	...	...	...	...	...	1·61	1·76	1·79	do.
	1931	Do. ...	...	...	...	...	...	...	1·59	1·66	1·75	...	...	...	Significant.
			...	...	...	...	...	...	1·85	1·85	1·93	1·80	2·02	2·21	do.
Non-fallow ...	1929	Gluyas Early ...	1·92	1·94	1·90	1·92	2·00	1·99	...	...	...	...	...	...	Not significant.
	1930	Nabawa ...	...	...	...	...	...	...	...	...	...	1·64	1·73	1·78	Significant.
	1931	Gluyas Early ...	...	...	...	...	...	...	1·66	1·76	1·80	...	...	...	Not significant.
			...	...	...	...	...	...	1·90	1·97	2·05	1·83	1·92	2·05	Significant.

METEOROLOGICAL.

Rainfall in points recorded during the course of the experiment.

Month.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
					Conventional Growing Period.									
1929	22	217	85	...	261	426	172	140	35	141	1,175	38	4	1,541
1930	7	...	53	92	66	367	321	149	90	55	1,048	1	98	1,299
1931	...	9	6	101	209	174	265	174	143	73	1,038	...	137	1,291
Average, 1925-1935	36	42	89	94	162	242	290	212	93	88	1,090	27	34	1,409

TABLE 7.

Effect of sulphate of ammonia as a fertiliser for wheat for grain—
(a) on yield of grain ;
(b) on nitrogen content of the grain.

CHAPMAN EXPERIMENT FARM.

Superphosphate—All plots received a basal dressing of 112-120 lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	1 cwt. Seeding.	½ cwt. Seeding, ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	None (Control).	1 cwt. Seeding.	2 cwt. Seeding.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow	1929	Nabawa	21 16	23 55	24 12	22 25	24 11	24 22	...	...	...	Not significant.
	1930	Do.	...	...	...	...	...	...	7 20	7 22	7 6	do.
	1931	Do.	...	...	...	...	...	...	19 46	16 2	15 18	Significant.
Non-fallow ...	1929	Do.	16 46	18 19	17 42				...	...	...	Not significant.
	1930	Do.	...	...	...	14 52	20 54	18 56	7 34	10 5	9 1	Significant.
	1931	Do.				...	...	...	18 46	19 41	19 52	do.
												Not significant.
			Nitrogen Content per cent. of Dry Matter.									
Fallow	1929	Nabawa	2·15	2·17	2·24							Significant.
	1930	Do.				2·18	2·16	2·31	...	...	...	Not significant.
	1931	Do.	...	...	...	...	...	...	1·50	1·43	1·44	do.
Non-fallow ...	1929	Do.	1·62	1·62	1·72	1·65	1·68	1·84	2·22	2·37	2·51	Significant.
	1930	Do.							...	...	...	do.
	1931	Do.							1·44	1·38	1·38	do.
									1·96	2·05	2·19	do.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Jan.	Feb.	Mar.	Apl.	Conventional Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
1929	...	40	20	10	424	643	189	190	73	35	1,554	106	3	1,663
1930	...	...	34	57	117	915	460	159	121	84	1,856	14	4	1,965
1931	...	...	12	61	459	241	486	273	200	96	1,755	125	56	2,009
Average, 1906-1935	30	41	79	65	240	416	393	280	159	96	1,584	30	26	1,855

TABLE 8.

Effect of Sulphate of Ammonia as a fertiliser for wheat for grain—
(*a*) On yield of grain.
(*b*) On nitrogen content of the grain.

AVONDALE EXPERIMENT FARM.

Superphosphate—All plots received a basal dressing of 120lbs. per acre.

Treatment with Sulphate of Ammonia.	Year.	Variety.	Average Yield per Acre. None (Control).	½ cwt. Seeding.	½ cwt. Seeding ½ cwt. August.	None (Control).	2 cwt. Seeding.	1 cwt. Seeding, 1 cwt. August.	Statistical Significance.
			bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	
Fallow	1929	Nabawa	25 26	27 17	24 54	26 48	28 48	26 15	Not significant.
Non-fallow	1929	do. ...	13 53	15 30	14 22	...	...	...	Significant.
			...	...	...	14 37	17 43	15 57	Not significant.

NITROGEN CONTENT PER CENT OF DRY MATTER.

Fallow	1929	Nabawa ...	1·98	2·00	2·23	...	...	...	Significant.
			...	...	...	1·99	2·06	2·22	Not significant.
Non-fallow	1929	do.	1·65	1·67	1·70	1·61	1·77	1·84	do.

METEOROLOGICAL.

Rainfall, in points, recorded during the course of the experiment.

Month.	Jan.	Feb.	Mar.	Apl.	Conventional Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total, May–Oct.	Nov.	Dec.	Annual Total.
1929		109	77	15	256	434	228	123	73	36	1,150	198	7	1,556
Average, 1928-1935	25	29	148	89	259	291	374	278	106	116	1,424	42	28	1,785

VERMIN DESTRUCTION.

A. ARNOLD,
Chief Inspector of Rabbits.

SOME NOTES ON RABBIT DESTRUCTION.

Of all the agencies of destruction that rabbits have to contend with in the struggle to exist, and to increase, the operations of man are undoubtedly the most destructive. Their numbers are reduced by carnivorous animals, parasitic diseases, the droughts of summer and the floods of winter, but the use of strychnine, phosphorus, poisonous gases and other methods of destruction applied by man easily account for the greatest numbers. The general application of poison during the main poisoning season followed during the winter with the fumigator and more poison where necessary, are the essential factors whereby the pest can be satisfactorily suppressed. But how are we to secure their effectual application? Only by organisation, adequate and effectual supervision, an abundant supply of poison, a firm judiciary, and the removal of those conditions which tend to the conservation of the pest and through which much of the best rural areas throughout the Commonwealth are being utilised to no more beneficial and legitimate purpose than feeding rabbits. Unless all these measures be applied, rabbits are liable to increase, and one measure without the other is of little use. Numerous suggestions have been made from time to time with a view to amending the system of administrative control, but no matter what the system of control may be, or how powerful the mechanism of the Vermin Act, the degree to which rabbits are suppressed will mainly depend upon the cost and accessibility of poison and other essential materials, the methods employed, and the extent to which those responsible for their actual destruction are dominated by a sense of personal responsibility to their neighbours and the State, or by fear of loss to themselves in cash. Legislative precepts and the imposition of light penalties are in themselves insufficient to prevent neglect. Ever since rabbits became a pest—nearly 50 years ago—the best brains in the pastoral and farming communities have been centred on the problem of how best to combat the difficulty. It can only be done by work. The man who protects his property by wire-netting, poisons in summer, and fumigates and poisons in winter, will not suffer serious loss. The Vermin Board's Inspector, who points the way whereby that work, wherever it is necessary, will be carried out conscientiously and earnestly, will materially assist in solving the rabbit problem.

In dealing with the rabbit pest, there is only one really effective way, and that is to net in the holdings with rabbit-proof netting. It may cost a little more at the time, but will be infinitely cheaper in the long run. The Government and Vermin Boards are authorised to supply wire-netting and other appliances for the purpose of making holdings rabbit-proof, and the repayments of capital and interest would often be much less than the cost of constantly poisoning and destroying.

Where netting is not used, the most efficacious way of dealing with the rabbits is by poisoning, and, if prompt steps are taken at their first appearance, the expense may not be very heavy, as they will be prevented from settling down and getting a footing; but if these steps are neglected at the start, the expense in time may become very serious. It should also be remembered that poisoning in country not protected by a rabbit-proof fence will never eradicate the rabbits; the most that can be hoped for is that they may be kept in check, and thus this expense will be a continuous one.

At times settlers are apt to resent the visits of Inspectors, but it should be remembered that the Vermin Act was framed for the protection of the settlers, and in their own interests they should do all they possibly can to carry out its provisions and see that their neighbours do likewise.

The rabbit has a number of natural enemies in this State, and the principal of these are the fox, the native cat, the long-tailed goanna, the larger hawks and owls, and of these the fox is by far the greatest, and in many districts his destruction of a few lambs or turkeys is overlooked on account of his all-the-year-around destruction of rabbits. Natural enemies, however, will never keep the rabbit pest down sufficiently, and must only be regarded as an aid to the settlers' own efforts.

In the following pages full instructions are given as to preparing and laying of various poisons, and preparations thereof. The recipes are from those adopted by the South Australian, Victorian and New South Wales Rabbit Departments, and from any other sources I have been able to cull them.

In addition to Notes on Rabbit Destruction there are also articles dealing with other kinds of vermin.

The cordial co-operation of all is asked, as it is only by this that the rabbit pest can be kept in bounds at a minimum of cost.

THE RABBIT INDUSTRY.

The wonderful boom the rabbit skin market occasionally experiences is apt to upset some people's perspective of the pest's real position, more especially as a continual menace to our greatest natural asset in the pastoral industry, and those who review the cold facts are not blind to the reality that the enhanced value of the pelt is a great incentive to the destruction of the pest, but to accept this as a proper reason for encouraging the systematic breeding of rabbits would be to undermine legitimate industries of the land.

Strange as it may appear, one frequently hears the argument that the rabbit industry is a very great boon to Australia; why should any attempts be made to eradicate them? Surely, they say, when hundreds of people are doing so well, you do not want to close this avenue of wealth. This question, like every other, has two sides, and it is only by considering it all round that we can arrive at a right conclusion. Admitting that some thousands of pounds are gained every year by those who engage in the frozen rabbit and rabbit skin trade, yet we have also to estimate the loss, and who can rightly do this? What has been the cost to land owners for poison carts and other means of destruction employed? Consider what enormous sums have been spent in wire-netting in endeavouring to check the ravages of this pest. Out of this who can tell the depreciation in land values as a direct result of the rabbit invasion? If it were possible in any way to place columns of figures in comparison, the result would certainly surprise the whole community. Australian wool and wheat have long held a prominent position in the world's markets, but if bunny once gets the upper hand it would be ruinous to those staple products. At best the demand for frozen rabbits is limited; the market would be glutted, and this is also true of the fur trade, as has been manifested at times by the sudden collapse of the market.

TRAPPING.

Trapping is strongly deprecated, especially allowing any outside persons to trap for profit, as their idea is not to exterminate rabbits but to catch the most marketable, which are the bucks, and as soon as the catches are not profitable they leave the place until they breed again. If there is a colony of rabbits on a

place, trapping should never be used to get rid of them, as although some will be caught, others will be frightened away and thus spread and be more difficult to destroy; poisoning should always be adopted.

Trapping is only advocated by those who have very little knowledge of rabbits. The Vermin Departments in all the Eastern States, after years of experience, agree that it is not only ineffective but harmful. Trapping the rabbit is similar in result to the pruning of a fruit tree—it eventually increases production. One morning's work with the fumigators now available would, especially in the winter months, be more effective than months of trapping.

Experience in this and the Eastern States proves that trapping does not reduce the pest but rather tends to increase it, and I think any practical stockman will see the reason from the following illustration:—Careful examination of young rabbits shows that the sexes are nearly equal, there being a slightly greater number of males; the proportion is about 47 females to 53 males. Amongst sheep the proportion of ram lambs and ewe lambs is something similar. Would any practical farmer think of putting a hundred rams with a hundred ewes and expect anything like a good lambing? If he did he would be sadly disappointed. What he does is to put about two or three rams to a hundred ewes and thus gets the best results. In trapping often as much as 70 to 80 per cent. of males are caught at first. There is a variety of reasons for this—one is that the buck rabbit, being larger, fetches a better price, and the trappers use special methods to catch the bucks; another reason is that from the habits of the buck rabbit it is much easier to trap, as they go to one particular place to deposit their droppings, and the trapper knowing this, sets his trap accordingly. Again, the male is usually the more fearless and is first out of the burrows and on the feed runs, and naturally first on to areas where the traps are set, and for other reasons the trapper does not desire females, hence he sets his traps in zones where his experience tells him they are least likely to be found. The result is that by reducing the number of bucks, the fertility of the does is greatly increased and the breeding period greatly lengthened. Actual experience in this State has shown that, on properties where trapping was carried out late in the season, when practically all breeding had ceased in that district, the only does found to be in young were round one particular farm where trapping had been carried out all through the summer.

At the best it is only a temporary relief—a kind of lessening for the time being—with greater trouble later on. A good breeding season always follows trapping because of the great proportion of bucks that are caught as compared with does. The latter always breed better when the males are in a small proportion. Anyone who digs out burrows after trapping is finished, and sexes the rabbits obtained, will be surprised at the great percentage of does. Then again, the trapping out of burrows and filling up of same is bad work. Long before the rabbits belonging to the burrow can be caught, a big percentage of them will clear out and find temporary lodgments anywhere in the surrounding country. The land owner flatters himself presently that all have been caught and has the burrows filled in under that impression. In a very little while, when the temporarily dispersed rabbits find that all is quiet, they will return and re-occupy their old homes, much to the indignation of the land owner, who often thinks that he has cleared his place, and that fresh rabbits have come from the adjoining country instead of being his own come back again.

As a matter of fact, any trapping will cause a large proportion of rabbits to leave the vicinity for the time being.

Trapping, consequently, is not recognised by the Department as a satisfactory method of destruction, and inspectors will see that other and more complete measures follow.

The Department only recommend trapping as a final "mopping up" process at the burrows after fumigating and poisoning has reduced the pest to a minimum, and then only on holdings enclosed with rabbit-proof fences.

Farmers in the Eastern States are against trapping.

Queensland.—Gregory North and Darling Downs Conference, 1916: Extract from report:—"We find that trapping is not effective as a means of destruction."

New South Wales.—Pastoralists' Conference held at Hay, November, 1922:—"We are strongly of opinion that the professional trapper should not be encouraged, and that all members be circularised to this end."

Victoria.—The South Gippsland Farmers and Graziers' Association, Annual Meeting, held October, 1922: *Carried*:—"That the Vermin Destruction Department be requested to prevent any trapping being done in the Association's territory."

South Australia.—Extract from evidence given by Mr. John F. Cunningham, Pastoral Inspector for Messrs. Dalgety & Coy., at Conference held November 28th, 1916:—"Trapping does not keep the pest down; if you trap, the rabbit increases."

SOME STRIKING FACTS.

There are some very striking facts that justify this statement. Wherever the sexes of rabbits secured by trappers are investigated, it is found that from 80 to 90 per cent. are males; conversely, where poisoning operations are effectively carried out on land that has recently been trapped, the poisoned rabbits are nearly all does. Some years ago the Victorian Vermin Destruction Department took in hand the poisoning of rabbits on Restdown Estate near Rochester. The men employed in the work took possession of the ground just as some skilled trappers left it. The general verdict in the district was that the latter had left no rabbits behind them. Poison was laid, and in the presence of witnesses the departmental Inspector gathered 2,996 rabbits, of which, on examination, only twenty-two were found to be males. Poisoning operations on recently trapped country at Allambee led to the destruction of 995 adult rabbits, out of which 895 were females. In the early part of this year, of 7,000 rabbits poisoned in the Daylesford district, 85 per cent. were females. Within a ten-mile radius of Lancefield Junction, in territory that had been heavily trapped, 100,000 rabbits were recently killed by poisoning, of which 85 per cent. were females.

TRAPPING IS NOT AN EFFECTIVE MEANS OF EXTIRPATION.

There are plenty of other instances showing both the efficacy of the departmental methods and the very high percentage of females that are destroyed by such means. If poisoning on these lines is adopted during the breeding months, which range from June to October, the destruction of each female practically means the destruction of 25 descendants, which figure represents the average reproductive capacities of a doe in the course of a year. This fact establishes the importance of winter poisoning, and also explains why the rabbit trapper, so far as possible, avoids catching female rabbits. The following interesting episode in the recent history of a trapper in our wheat belt carries its own moral. With the proceeds of money earned by trapping he acquired a property adjoining that on which he had previously pursued his calling. He was asked if he was going to clear it by trapping. Somewhat to the indignation of local land owners, to whom he had always

before extolled the merits of trapping, he made the following significant reply:—"If you men were foolish enough to grow rabbits to provide me with funds to take a farm, I am not fool enough to let anyone else come the same game with me. I am going to poison and fumigate it, and when I can afford it, wire net."

Briefly the main reasons against trapping are:—

(1) Trapping increases rabbits. The experience of the Eastern States for the last 40 to 50 years shows that trapping for market never reduced the rabbits anywhere.

(2) The majority of rabbits trapped are invariably males, leaving a preponderance of does, most of which breed all the year as against three or four months only when the balance is not disturbed. If 50 rams were left with 50 ewes, the lambing would be very low.

(3) Rabbits gather in colonies, where they can be successfully dealt with—trapping scatters them.

(4) Trappers stay only as long as it pays them; then they move, leaving the rabbits in ideal conditions to refill the breach.

(5) The commercial aspect of the rabbit trade is totally opposed to extermination. The rabbit trapper is not an exterminator but rather a promoter of propagation; his occupation depends on it.

(6) Sheep as a commercial commodity are bred without injury either to the land or others: rabbits are also a realisable commodity, but are a source of danger to the surrounding farms, besides practically destroying indigenous feed.

(7) To ignore the experience of the Eastern States, where rabbit trapping has proved beyond doubt to increase the rabbits, is to adopt a policy of drift. Concentration along proven lines should be determined upon (*i.e.*, poisoning and fumigating).

(8) Because rabbits are of some little value many short-sighted farmers are disinclined to poison, anticipating to make a few pence from the carcases or skins; such individuals are a menace to the surrounding farmers and the district generally, and each Board should see that its Inspector enforces such delinquents to carry out the destructive clauses of the Act.

METHODS OF DESTROYING RABBITS GENERALLY ADOPTED.

Rabbit destruction falls roughly under the following heads, Poisoning, Fumigation, Trapping, Digging-out and Digging-in, and there are a number of different poisons and fumigants, and methods of using them are described under their respective headings.

Of the poisons, phosphorised pollard is one of the most effective and one of the cheapest, and, if mixed according to the directions given in this paper, there is no danger whatever of the baits catching fire after being laid out.

Most settlers will find it more convenient to purchase some of the prepared phosphorus preparations that are on the market; they are effectual, and no danger is attached to handling them.

Strychnine is a good poison, especially when used in jam or with apples or carrots.

Cyanide of potassium for poisoning water is a cheap and efficient remedy for destroying rabbits in dry areas, especially where waters at which the rabbits have been used to drinking can be fenced off with wire netting.

Within netted areas rabbits can be practically exterminated provided permanent harbour and cover, including warrens, are destroyed. This means work and is no easy matter, but in the long run will save much valuable time and will be found a profitable project and yield a substantial return. There is no truer axiom than "Aim at the rabbit and you miss him; aim at his cover and you hit him." If he is put on the surface without harbour the problem is solved.

When a holding is thoroughly cleared of all harbour for rabbits such as burrows, hollow logs, fallen timber, and thick scrub, it is comparatively easy to keep the rabbits down by dogs. Fox and Irish terriers and whippets, or cross-bred whippets, would be found very useful for the work.

As soon as a burrow is seen it should be dug out or fumigated and filled in.

When rabbits have made burrows amongst rocks or amongst stones, one of the best ways of getting rid of them is to put a plug or more of dynamite or some other explosive as far in one of the holes as possible, then fill up the hole and tamp it hard and explode it; this will generally close up all the other holes that are near, but a close examination should be made to see that all the holes have closed effectively.

When rabbits have a number of burrows or warrens, they can be very effectively destroyed by the use of carbon bi-sulphide, the fumes of which are pumped into the holes, and when the burrows are full of the gas they are closed up and every rabbit therein will die. Special fumigating machines are made for this work.

By the use of ferrets and nets, burrows can be completely cleared out, but the work can be done cheaper and better by the use of a fumigating machine.

In this State rabbits only breed when green feed or water is available; the fencing in of water holes and using fairly high troughs for the stock to water at will be found a good preventive; care must be taken that the troughs do not leak and form a puddle underneath, as the rabbits get water there.

The netting in of dams and forming such enclosures into traps by inserting funnels in the netting on each side, thus allowing rabbits to enter and ultimately to find their way into enclosed traps erected in the corners, is a good method that can easily be adopted in dry weather and where water is scarce. The funnels can be made of netting rolled cylinder-wise, about 18in. long and 6in. wide at the larger end tapering to 3in. at the smaller end, this latter end being left as jagged or rough as possible. When inserting into the fence the funnels should be placed just slightly below ground level so that the rabbits will not have to run over the netting. Similar cones are inserted in the enclosed traps. Rabbits in their endeavour to get out, keep close up to the fence and fail to find the only way out.

METHOD OF LAYING POISON.

For any poisoning, undoubtedly the furrow or scratch is far and away the best. Nothing can equal it for certainty. The attraction to the rabbit is irresistible. It will always come to it to play and scratch on, and therefore must find the bait sooner or later. But when the country does not allow of the use of the plough or the sledge the soil should be upturned by other means. Cases have been noticed where the top of the ground has been smoothly taken off, and the poison laid thereon. This is not advisable—the ground should be broken, not smoothed over. As a rule, the poison is not so freely taken if laid near burrows. It is much more certain if put on their feeding and playing ground, still, an exception can be made during the breeding seasons—baits can then be laid quite close so as to catch the very young rabbits that are too young to do anything but dodge about the mouth of the burrow.

The youngest of these, as long as they are old enough to nibble grass, will freely take apples, carrots, or pollard, well sugared. There is a general belief that the only proper time for poisoning is during the summer months when the grass is dry. This is quite a mistake. There is no time of the year, whether summer or winter, wet or dry, plenty of feed or no feed, or any kind of country, that rabbits cannot be got to take—and take well—some kind of poison. They will always take fruit or carrots, and, if pollard is well sweetened, will not refuse it either. It is merely a question of intelligent and judicious poisoning.

Many poisoners think that, where sweetening is necessary, treacle is more attractive than sugar, and in the summer time it retains moisture longer and is the cheaper of the two.

It is well to remember, however, that the addition of sugar, honey, or molasses, although making the bait more palatable keeps it moist for a longer period, as being hygroscopic, they attract moisture from the air, thereby retarding the oxidation of the phosphorus, and rendering the bait poisonous for a longer period. The placing of stock in poisoned paddocks is usually safe after seven or 10 days during the summer; changing weather conditions might even lengthen this period as would also be the case if baits were laid amidst pastures and protected from wind and rain. With molasses added it would be wise to double this period, the same would apply if it was mixed double strength.

Great care should in all cases be exercised as to cleanliness in preparing poisons and laying same. The rabbit is cleanly, and keen to detect anything suspicious in the food spread for it.

Poisoning operations, however successful, should always be followed up by other means. There is always a percentage of vermin left quite sufficient to breed up again. These should be got at by digging out and fumigation, and even trapping, if it is carried out not for profit but if done continuously and with the object of getting the last one. Trapping, however, tends to scatter the pest, causes them to clear out and find temporary lodgments anywhere in the surrounding country only waiting to come back again to their old homes, and because of this it should be avoided. But it is undoubtedly best to always destroy the burrows. No work is complete without this. If these are left the house is always awaiting tenants, and be sure they will find occupants sooner or later. This action, coupled with the destruction of harbour, such as fallen timber, log fences, hedges, etc., is the crux of rabbit destruction, and. if properly followed, must lead to success.

Poisoning is the most effective way to deal with rabbits when rabbit-proof netting is not available. The later in the evening the furrow is made and the poison laid, the better the results.

There is no time of the year in which rabbits will not take some kind of poison.

When grass is young or green feed abundant, poisoned grain will often be taken when other poisons will not be looked at.

The fresher the baits the more likely they are to be taken.

Sometimes the baits will be taken better if a decoy is added. For use with pollard a few drops of oil of aniseed or Amyl Acetate often give good results, and for jam poisons Oil of Rhodium.

There are various opinions amongst experienced poisoners as to whether the smell of the human being on the baits is injurious or not, but it is just as well not to touch the baits with the hands more than can be avoided; a stout spoon or a piece of wood will do most of the work.

DIRECTIONS FOR MAKING AND USING DIFFERENT POISONS.

PHOSPHORISING POLLARD.

Phosphorous compound put up in 2 lb. tins can be obtained from Vermin Boards who in turn, by an arrangement made between the Agricultural Department and the wholesale chemist and druggist firms in Perth, can obtain their supplies of this and other poisons at lowest wholesale rates. Full directions for use will be found on each tin, but, if not legible, then proceed as follows.

Take a large (3 or 4 gallons) bucket (see that it is perfectly clean) and into this place six quarts of good clean water. Empty the contents of a 2 lb. tin of poison into same, taking care to clean out all of the contents of the tin, and mix thoroughly. Add sufficient pollard and bran, in the proportion of four parts pollard and one part bran, to the liquid to form a good stiff dough. This can be kneaded, adding a little more pollard if required, and if two or three drops of oil of aniseed are thoroughly mixed in it will permeate the bait and make it more attractive to the rabbits.

The bait can now be distributed by means of the poison cart or, after being cut into cubes as described hereunder, by hand.

When preparing the baits to be laid by hand a good way is to knead it up like a damper, then flatten out by beating it with a flat stick or board until about a quarter of an inch thick, then cut it across both ways with a knife, the cuts about quarter of an inch from each other, and this will give cubes about quarter of an inch square; dust a little dry pollard over them and they can be put in a billy or box and handled easily for distribution. Another method is—

Rolling out.—Have a clean board and a roller, and keep them well dusted with dry pollard. Take about two handfuls of the dough out with a flat stick, throw dry pollard on it to stop any sticking, knead it well by hand, and roll out to ¼-inch thick. Cut the cake so as to divide it into ¼-inch squares, and throw the ragged edges back in the pot. Gather up the squares with the dry pollard, etc., and place in a box with more dry pollard. The poisoned pollard should be dropped in a furrow at distances from two to three feet, or further apart according to the number of rabbits about.

Great care should be taken to give the rabbits tasty and clean food, as little changed from its natural condition as possible, as they are cleanly, and keen to detect any suspicious appearances surrounding the food spread for them.

Complaints have often been made about rabbits not taking the poisoned pollard and on investigation it has generally been found that the fault was in the pollard. Either it was mouldy or old and smelt sour or smelt of mice; under these conditions rabbits will rarely take it. The freshest and best pollard and bran should be used.

When rabbits do not take the phosphorised pollard freely, if, when mixing it up, some quince jam, or if that is not available, raspberry or other jam, is mixed with it good results may be obtained.

It has been found that 3 lbs. of minced apples and 1 lb. of sugar added to the pollard used in mixing 1 tin of poison is a great attraction where rabbits are "fussy." Where they are plentiful and hungry this addition is not at all necessary.

Method of Laying.

Where the holdings are large it will pay to use a poison cart. This is a light cart fitted with a share to turn up a small furrow and to deposit phosphorised pollard baits automatically. They can be adjusted to lay the baits at various

distances apart. By the use of a poison cart a man and a horse can lay 16 miles of baits a day and most effectively. They can be laid in the open or can be laid and covered over with a light layer of soil, and some poisoners report that they get even better results from the covered baits than from the ones left uncovered. Where sheep or other stock are about it is decidedly better to cover the baits.

Poison carts can be bought for about £20 to £25. Cheaper makes are made mainly on the sledge principle, and there is also a machine on the market for attaching to the axle of a spring cart or sulky; the price is in the vicinity of £10, and are suitable for farm use. Other small appliances are on the market from £3 10s.

On smaller properties an ordinary plough furrow may be run or a home-made arrangement with an old cultivator tine. A cheap and effective implement can be made out of a bush sled; a cultivator tine is fixed in the centre of it towards the front and a box to hold the baits is fastened on. A man or boy can drive a horse and drop the baits in the furrows as he goes along. For smaller places a mattock, hoe, or other implement can be used to turn the ground up and the baits dropped where the earth has been turned out.

The turning up of the soil is very important, as there is something very attractive to a rabbit in freshly turned up earth, and rabbits will often run for hundreds of yards along a newly turned up furrow. Consequently if furrows are run on all sides of a paddock almost every rabbit that strikes a furrow will run along it for some distance and thus find the baits.

There are small hand hoes combined with an automatic poison distributor on the market that save time and trouble, and are economical in the use of the poisoned pollard.

It should be remembered that phosphorus is a slow poison and the rabbits as a rule die in their burrows or logs, and consequently not many dead ones will be seen; but, if slow, it is very deadly, and the smallest bait will kill, so that so long as the baits are being taken it is certain that the rabbits are dying.

It is not much use putting down poison now and again, it should be done regularly until the rabbits disappear.

It is necessary where rabbits are numerous to lay out plenty of baits. If there are thousands it is no use only putting out sufficient for say three hundred, as you are going to educate the 700 not to eat it as they become very cute when they see their mates dying. Plenty of baits and get them out as quickly as possible is the best method, remembering that one hefty rabbit will run along and pick up a number of baits and will drive the others away until he has had his fill.

Newly turned up furrows should be made each time poison is laid.

The following directions for mixing and laying phosphorus poison should be observed:—

Before using at any time the tins of poison must be thoroughly shaken.

If the contents of the tin are not thoroughly mixed, there may be danger of fire.

In opening a tin some of the contents may fly out, and care should be taken to make only a small hole first, and to wrap some cloth or paper round the place where the hole is being made. The larger hole should be made by a round implement so that a cork can be fitted tightly in.

Where a whole tin is used at a time 12 pints of water are to be added.

This is sufficient to make about a kerosene tin full of poisoned pollard and bran, and will do from 7 miles upwards according to how close the baits are laid.

If fowls or stock are about, phosphorus baits may be covered with about ½in. of soil, but this will not protect pigs.

When only portion of a tin is used, measure out about as much as is required, and add six times the same quantity of water; then add the pollard and bran and mix up into a good stiff dough.

The pollard and bran should never be laid sloppy or wet. If made as stiff as for a damper it will be about right.

Baits should be mixed up in the afternoon and laid fresh.

If long furrows are made, it is as well to break them here and there, as sometimes the rabbits run up and down and tread over baits.

Everything used in mixing the pollard and bran should be clean; if dirty utensils are used, the rabbits may not take the baits. Use the hands on the pollard and bran as little as possible unless oil of aniseed has been rubbed on the hands first.

If pollard and bran are musty or smell of mice, rabbits will not eat it.

Never lay more than is needed. In the worst districts, 2 or 3 feet apart is close enough, and in other districts they may be laid up to 9 feet apart.

When a tin is opened and not used, it should be kept tightly corked, and then it will keep for several weeks.

In laying poison when green feed is about, the furrow should not be run in the headlands or amongst the green feed as the rabbits will often then refuse to take the baits.

Much better results will be obtained if the furrows are run a few chains away in the direction from which the rabbits come, and in the barest places, or through the scrubs.

The phosphorus poison should not be used with wheat unless first mixed into a paste as described, as fires are apt to occur.

PHOSPHORISED OATS OR WHEAT.

Quantities: 60lbs. best grain, 4 gallons water, about 9ozs. phosphorus. Dissolve the phosphorus in carbon bi-sulphide and water. Make a half-gallon of thick paste with flour and boiling water, free from lumps. Place the grain in a revolving machine made for this purpose. When the paste is cold, pour the dissolved phosphorus, etc., into it, and stir well until the ingredients are thoroughly mixed. Make a hollow space in the grain to receive the paste, and pour it into it. Move the machine to and fro until the grain has caught up all the paste (say, three or four minutes), then turn the machine gently. When the smoke which is created is sufficiently dense to hide the grain from sight, turn it out on to clean bagging, spread out in a shady place on, say, some sheets of iron; keep stirring the wheat until all sign of smoke has disappeared, when it will be shortly ready for use. The above strength of phosphorus gives the best killing results. Using a greater strength may defeat the object in view by setting up oxidation. Many failures are due to this. Although grain may be prepared in open vessels, the use of the revolving machine is infinitely surer and safer.

STRYCHNINE POISONING.

At certain times of the year poisoned apples are one of the most deadly baits that can be offered to rabbits. They cost more than some other poisons, but if properly used almost every rabbit that comes to feed where it is laid down can be destroyed.

In the using of apples on no account should they be poisoned for the first few nights. The apples should be cut into pieces about half an inch square and laid from two to six feet apart, according to how plentiful the rabbits are.

It is desirable to give two or three feeds before laying the poisoned bait, and care should be taken to make the free bait attractive. Where possible select only fruit that is sweet and sound. The addition of a little sugar both for free feeding or when mixed with poison is advised also, as it is necessary to have the unpoisoned and poisoned bait as attractive as possible. The rabbits not being used to them, may not take them freely for the first night or two. When they are being taken freely then they may be poisoned.

When preparing the bait the apples should be cut into small cubes about half an inch square. If sour apples only can be obtained 1 lb. of sugar should be sprinkled on to each 12 lb. of bait. Mix the sugar with the bait, then lay it out on a bag for some time to drain. Place 2 or 3 lbs. of bait in the mixing vessel, then sprinkle a little strychnine on it and mix thoroughly. Add more bait and sprinkle more poison until the whole quantity required has been mixed. One ounce of strychnine should do 12 to 16 lbs. of apples. If the strychnine is not in the powdered form, it will be necessary to grind it finely with a pestle and mortar or by rolling it with a bottle on strong brown paper or suitable substance before placing it in a pepper castor or suitable round tin with a perforated lid. As strychnine does not run freely it is a good plan to mix about one-third its bulk of cornflour or ordinary flour with it. It will then run freely through the holes.

The baits are laid about 6 ft. apart in furrows which should be run as closely as possible to the infested spots and be situated in such a way that the rabbits have to cross them to reach their feeding grounds. Where the country is eaten out and polluted, as occurs in the dry season, furrows should not be drawn close to burrows, as the rabbits may travel some distance to their feeding grounds without stopping. During the breeding season where grass is plentiful, a number of kittens will be accounted for by laying bait near the burrows.

The matter of free-feeding is of such importance that the advice of the late Chief Inspector of Vermin in Victoria, Mr. F. E. Allan, on the subject, is reproduced, which reads as follows:—

THE ART OF FREE-FEEDING.

All animals or birds that collect in any number have amongst them a proportion that rule or "boss" the others. This is especially so as regards the rabbit. When the "free-feed" is found, the stronger ones will take possession, and hunt or keep the others away till they have eaten their fill; and none may then be left to educate the balance. Anyone who will take the trouble to lie in hiding and watch the freshly laid furrows will see the stronger take possession, and hunt the weaker away. I have had a practical experiment in my own garden, where a rabbit ventured to make a home under my residence. It ate no less than 35 half-inch cubes in one night, and this despite the fact that it had a vegetable and flower garden and a lawn to feed over. Probably it would take a good many more where such good feed was not available. The next day when it is found that *all* the feed is gone, most people relay the same quantity. This is again eaten by the same ones that had it before, and so on, till the poison baits are laid, when, of course, only those that have been "educated" are killed. The others have not had a chance to acquire the taste, and, as is most likely the case, if there are poisoned baits left in the furrows, it is just the same to them as if there had been no free feeding at all. The rabbits only get to the baits

because the stronger rabbits are killed, and certainly will not take the poisoned baits under such circumstances. If this were not so, what would be the object of free-feeding at all? It is, of course, plain that free-feeding means the partaking by the rabbits of a lot of baits, while only a very few are taken when poisoned. Now, the essence of the work is this: When the free-feed baits are *all* taken (eaten) the first night, a far larger quantity must be laid the second time. If this is all eaten, then still more the third time. If still all is eaten, enough must be used to have some in the morning, and then, if there is a good deal left, stand off for a night, and let the rabbits clean it up before any poison is laid. The essential thing is to make sure that *all* the rabbits get the free-feed, and this can only be done by finding that some is left over. Practically a clean sweep can be done by this liberality. A man may get 700 or 800 out of 1,000 with insufficient free-feeding; but the man I want is he who can get the other 200 or 300, and this he can do by following out these instructions. Most land-holders stint both the free and poisoned baits—most false economy possible. As a matter of fact, there is no need in free-feeding to study the distance between the baits where rabbits are plentiful. Simply scatter them along the furrow liberally. I have known places where rabbits are so thick that the same could be done with the poisoned baits, *i.e.*, a rich flat, or such like, where they congregate for feed. It is hardly possible to err on the bountiful side; but very easy to be the other.

The wonderful results of the present methods are becoming more patent every day; and, if failure follows the work, it can only be put down to one of two things —incapacity or indifference, with, of course, future trouble to follow.

F. E. ALLAN,
Chief Inspector V.D. Act.

A pound of apples should make from 250 to 300 baits, an ounce of strychnine should therefore make about 3,000 baits.

Where large areas are to be done an apple-cutting machine will do the work of four people in cutting up apples. They cost about £5.

One of the best varieties of apples for the purpose is the Rokewood; it is a good keeper and firm, and about the cheapest on the market. If the apples used are on the sour side a little icing sugar should be dusted on them after the strychnine has been added.

If apples are not available, quinces or pears may be used, also carrots, swedes, or pie melons. If these three latter are used some sugar should be dissolved in water and made into a syrup and sprinkled over them, as the acids on them do not dissolve the strychnine readily, and with the syrup added the poison will stick to them.

As in the case of phosphorus poisoning, a furrow should always be run.

JAM AND STRYCHNINE.

If at some times of the year rabbits do not take phosphorus readily they may take poisoned jam, and made up as follows it will often give good results:—

1oz. of finely powdered strychnine to 20lbs. of jam. Quince and raspberry jam give best results.

The top of a round match-box that holds wax matches holds about 1/10th of an ounce of strychnine.

A few drops of oil of rhodium added makes it more attractive.

Strychnine can be dissolved in vinegar as well as in acetic acid.

Strychnine used with apples, pears, quinces, swedes, or carrots—1oz. to 16lbs.—gives often very good results. Where any of these are used the baits should not be poisoned for at least two nights, or until it is seen the rabbits take them freely. Any of these should be cut into cubes about ½in. square.

Of all the jams quince is much the best, as the rabbits are attracted by its natural flavour.

If the jam is made at home only about half the usual quantity of sugar should be used, and if to be kept for any length of time a little boric acid should be added to make it keep.

If bought jams are used and quince is not available the next best is raspberry. To 8lbs. of either of these jams add half an ounce of very finely powdered strychnine. Mix very thoroughly—on the thorough mixing the success depends. The jam, in pieces about the size of small marbles, may be laid in the furrow on stones, chips of wood, or pieces of bark. Rabbits thus poisoned will generally be found near the baits.

To poison a small quantity of jam take a 2lb. tin of jam and as much finely powdered strychnine as will fill the top of a wax-match box. Mix thoroughly with the jam and then add pollard so as to make a good stiff dough of it.

CARROTS AND STRYCHNINE.

Poisoning in this form is very effective in winter, when the carrots are fresh and crisp. If carrots are allowed to become soft and dry the rabbits do not eat them so well. The method adopted is a follows:—

Carrots are prepared in the same way as apples. In this case *the addition of sugar is essential*, otherwise the strychnine will not adhere to the bait.

The carrots when cut and mixed with sugar must be allowed to drain on a bag before dusting with strychnine. After dusting the baits all over they can be turned and dusted again, and they will then be ready for laying.

Cut up 15lbs. of carrots into small cubes, add 1lb. of icing sugar, and drain off any liquid after the sugar has dissolved. Lay the sweetened cubes in light plough-furrows or scrapes, two cubes every 4 yards apart. Feed in this manner for three nights, and if the rabbits eat the carrots proceed as follows:—Cut up 12lb. of clean carrots into small cubes, add 1lb. of icing sugar, and allow carrots to drain until all surplus liquid runs off; grind 1oz. of strychnine into fine powder, and sprinkle a teaspoonful at a time over the carrots until the ounce is all mixed, stirring well after each application of strychnine; then add 1lb. of icing sugar to cover taste of strychnine, and allow carrots to stand for two hours before laying. One poisoned cube every 3 yards is sufficient.

AN ALTERNATIVE METHOD.

One ounce strychnine (hydro chloride), 4 tobacco tins (2oz.) of icing sugar, ½ tablespoonful glycerine, few drops rhodium oil. Add water to make 1 gallon, and soak carrot chips, after draining, in same for 10 minutes, drain and lay baits along furrow.

OATS, MOLASSES, AND STRYCHNINE.

This method has proved very effective, satisfactory kills have been made, and it can be used at any season of the year. It has been tried when there was plenty of feed, also when feed was scarce, and in both instances results were good. The method is as follows:—

Boil 15lbs. of oats (Garton's preferred) with 2lbs. of molasses or treacle, and sufficient water, until the oats are soft, draining off any surplus liquid. The oats are then ready to lay for feeding purposes. Run light plough-furrows about 2 chains apart on the land where rabbits feed principally at night, and lay baits of

a dessert-spoonful every 4 yards apart in the furrows. In country too rough for the plough lay the baits in scrapes or spade chips. Continue this for three nights, and if the rabbits are then eating the sweetened oats well, proceed with the poison as follows:—Weigh out 24lbs. of boiled oats treated as before mentioned; pour into a wide bath or tub; grind 1oz. of strychnine to fine powder, and sprinkle a teaspoonful at a time over the oats, stirring well after each sprinkling until the strychnine is all mixed; after which add 2 lbs. of sugar to give a sweet coating, as the rabbits having been fed on sweetened oats, it is advisable to cover the taste of the strychnine. Allow the oats to stand for two hours before laying. In laying the poisoned oats, 1 teaspoonful is sufficient every 4 or 5 yards. The same furrows as were used for feeding purposes will do for the poison.

Points to Observe.

Special care should be taken that all utensils used in the preparation of the poison are perfectly cleaned. The strychnine should be ground as fine as possible, no grittiness to be observable.

POISONING TWIGS

There are two methods adopted:—

(a) Dissolve 1½ ozs. of strychnine in 1 quart of vinegar (or one-fifth of this quantity of acetic acid), then add to this 5 gallons of water. Add 2 lbs. of flour and 1 lb. of sugar to form a thin paste.

(b) Use 1½ ozs. of strychnine to 1 gallon of water, and 2 lbs. of flour and 1 lb. of sugar to form a thin paste. In this the strychnine should be ground between two pieces of glass before being placed in the water, as otherwise it will not be held in solution.

The mixture is applied to the twigs of bushes that rabbits eat, either by means of a brush or dipping them in the solution.

After preparation all that is required to be done is to scatter the poisoned twigs wherever the rabbits exist.

Special attention is called to the possible danger to stock if the poisoned leaves are left where they can have free and unguarded access to them, as stock will eat the leaves but refuse the twigs, which are, however, readily eaten by the rabbits. This danger can be avoided by spreading only the poisoned twigs. A few unpoisoned leaves may be left, however, attached to the twigs, to attract the attention of the rabbits. Twigs of apples, pears, or quinces or of any native shrubs that rabbits are fond of can be used.

RECIPE FOR POISONING WHEAT.

The following recipe is for a coated grain bait:—Powdered strychnine (alkaloid) —1 ounce; baking soda—1 ounce; saccharine—1 teaspoonful; laundry starch —½ cupful, and grain—20 pounds.

Add the starch, saccharine, baking soda and strychnine to 1 quart of water. Gently heat until a clear paste is formed, stirring continually. Pour the paste over the grain and mix thoroughly so that every kernel of grain is well coated and then spread out to dry.

A soaked grain bait:—Strychnine, hydrochloride or sulphate—1 ounce; cheap brown sugar or golden syrup—4 pounds; grain—20 pounds.

Dissolve the strychnine and sugar in about half a gallon of boiling water. Pour it over the grain and add enough water so that the liquid covers the latter. Simmer it very gently or allow it to stand for several hours so that the poison

is absorbed. If arsenic is used instead of strychnine, substitute 1 lb. of arsenate of soda for the ounce of strychnine. In the case of arsenic, boil until thoroughly dissolved, when the water should become tea-coloured and no white sediment should be visible on the stirring stick. Add the sugar and then pour the contents over the wheat or oats. If ¾ lb. of washing soda is added it will facilitate the dissolving of the arsenic.

Leave the mixture in a tub or vessel for about 8 hours, when about 1½ gallons should be absorbed. The grain can then be spread on bags or iron to dry when it is fit for putting in tins for future use. In some cases the grain will absorb more water, but this can be regulated. Poisoned wheat could not be laid by the ordinary poison cart that is made for laying phosphorus pollard baits.

POISONING WITH ARSENIC.

Arsenic is readily procurable on the market, in some form or another. It is sparingly soluble in water and on this account it is necessary to boil same. Its action is exceedingly variable and this, combined with the uncertainty of results, is the chief objection to its use.

It is not looked upon as favourably as strychnine as a poisoning agent as it imparts a sour metallic taste to baits and on this account it is not readily taken and judging by results, although cheap, it is not as economical. Arsenite of soda can be substituted for white arsenic. It is more soluble and palatable and on this account is to be preferred.

ARSENIC AND WHEAT.

Three-quarters kerosene tin wheat (about 20 lb.); 1 lb. arsenic; 2 ozs. washing soda; 1½ gallons water. The addition of 2 lb. of sugar would tend to make the bait more palatable.

Boil together till arsenic is dissolved, then pour over wheat and add water till wheat is just covered, stir well and let stand until wheat has absorbed all liquid.

Lay bait in a trail made by spade or hoe around burrows and along runs from cover. The wheat should be laid in small heaps, about a tablespoonful. By doing this the wheat not eaten can be either picked up or easily buried.

ARSENIC AND APPLES, CARROTS, ETC.

One pound arsenic; 20 lbs. apples or carrots.

Cut bait into ½in. squares and sift arsenic on dry with a dredger. If carrots are used let them stand after cutting them to weep or drain. Damp them with a thick solution of sugar before sprinkling the arsenic; thoroughly mix when applying so that the poison will disseminate through the mass.

POISONED WATER.

In dry areas where water is scarce great destruction can be done to rabbits and they can be easily destroyed by the use of poisoned water, especially during the dry periods when they are compelled to congregate around water supplies. As this method is also likely to be harmful to all bird life, it is wise to place such poison out only after dark and take same up first thing each day. The method, of course, will vary according to circumstances. At times the ordinary troughing is used, when no stock are in the paddock, at other times it can be placed in small troughs or containers placed in such a manner that stock cannot get at it, but admit free entrance to rabbits.

When using poisoned water it is advisable to put pure unpoisoned water down for several nights until it is certain that the rabbits are drinking it. Sometimes it may be a few days or even a week before the rabbits will start drinking out of the vessels the water is put in. When it is certain they are drinking the water then the poison may be added. The vessels holding the poison should not be very large. Very good results are said to have been obtained by using old rusty, or other meat tins for poisoned water. The tins must not be too narrow, as the rabbit does not like to put its head into a narrow tin. These tins are filled with water and put on the runs or paths of the rabbits and a small piece of cyanide about the size of a rabbit-dropping put in each. This requires renewing from time to time, usually about every three days.

WATER AND CYANIDE.

Directions for Preparation and Use of the Solution.

One pound of cyanide (either potassium or sodium sodium is cheaper) is sufficient to treat 100 gallons of water. Do not use boiling water to dissolve the cyanide, it weakens the poison, and the fumes are dangerous. Formula for mixing:—Dissolve 2 ozs. of cyanide in water sufficient to fill a 2 lb. bottle (an ordinary beer or whisky bottle holds 2 lbs.). This quantity will poison 12½ gallons of water, which is all that is required for one night at a dam 2 × 1 chains in area. Cyanide at all times is of a volatile nature, therefore, when exposed it continuously becomes weaker, when mixed with water it does not remain poisonous for any lengthy period, in fact with some waters it will not remain poisonous for the 24 hours. If it comes in contact with anything of an acid nature it is readily given off in the form of gas. With most waters it will remain poisonous for three days or even much longer. The vessels containing the poisoned water should be placed in the most advantageous positions outside of the netting after sundown, and removed at daylight.

Troughs to contain poisoned water should be made of black steel, as the chemical action set up by cyanide when brought into contact with zinc or tin destroys those metals in a short time, whilst it has no effect on iron or steel. A further advantage is gained by the fact that they can be readily cleansed of all traces of poison by being submitted to action of fire.

WATER AND ARSENIC.

Arsenic 2 ozs.
Washing soda 4 ozs.
Water 1 gallon.

Boil these quantities until the arsenic is dissolved, add 2 ozs. sugar and stir well. For use add 2 gallons of water.

WATER POISONED WITH STRYCHNINE.

(a) One ounce of strychnine dissolved in one-third of a pint of acetic acid will poison 12 gallons of water; or

(b) Ten grains of strychnine dissolved in vinegar will poison one quart of water.

Some sugar should be added to counteract the bitterness of the strychnine or ⅛ oz. saccharine.

ARSENIC WATER FOR MICE.

This mixture, it is claimed, has been used for over forty years with much success. It is considerably weaker than the poison water generally recommended and contains no washing soda, points which are considered to make it more acceptable to the mice. It is pointed out that washing soda as an aid to dissolving the arsenic is not necessary if soft water is used, although essential when only spring water is available.

The directions are as follows:—

Boil in a five-gallon drum 1 lb. of commercial arsenic in 4 gallons soft water, no washing soda being required. Hang the drum up so that it boils from the bottom, otherwise the arsenic will not be completely dissolved. After boiling for about twenty minutes more water should be added to bring the quantity up to 4 gallons again. For use, 1 gallon of the mixture should be diluted with 20 gallons of water.

ARSENIC AND WATER FOR KANGAROOS.

2 lbs. arsenic.
1 lb. washing soda.
2 gallons water.

Boil for forty minutes and stir well whilst boiling, as this boils over very quickly and must be watched. This two gallons is sufficient to make 60 gallons of poison.

Place in a number of 5 or 6 gallon shallow troughs buried in the ground at the end of sheep troughing. Dry all other troughs. It is advisable to poison as many paddocks as possible on account of the mobile nature of the pest.

It is estimated 10 kangaroos to each gallon of water.

POISON WASH FOR FRUIT TREES.

Rabbits frequently do considerable damage to young fruit trees by nibbling the bark and practically ring-barking the trees so that they die. If the pest is numerous it would be by far the best plan to net the orchard, but where this cannot be done, the trees could be protected by using either of the following preparations which have been found effective. One mixture is with the view to repelling the pest from the trees, the other is a poison wash prepared as follows:—

(1) Dissolve 1 oz. of strychnine (sulphate) in three quarts of boiling water. Dissolve ½ pound laundry starch in 1 pint of cold water, stirring thoroughly. Pour the starch into the vessel containing the strychnine and boil the mixture a short time until the starch is clear. Add 6 ounces of glycerine and stir. When mixture is cold enough, apply to tree trunks with a paint brush.

(2) Raw linseed oil—1 gallon.

Sulphur powder—12 ounces.

Heat the oil out of doors in a five-gallon drum to 470° F. (243° C.). Measure the temperature with a thermometer—the oil gives off a bluish smoke at the temperature indicated. When the proper temperature is reached, remove the oil from the fire and begin adding the sulphur, a teaspoonful at a time, stirring constantly. The oil will become hotter and will foam a great deal. When all the sulphur has been added, a black ill-smelling compound will result. Allow the oil to cool completely before applying.

FUMIGATION.

The fumigation of rabbit warrens is one of the recognised effective means which may be adopted in keeping the pest in subjection, but it can never be looked upon as sufficient when employed alone, except in cases where the land is wholly cleared or on which there is no cover. If rabbits are on such land there must, of necessity, be burrows, as the rabbit cannot live without cover of some kind. Therefore, to protect himself from natural enemies, he is forced to go underground, and is then easily dealt with in traps of his own forming by fumigating the warrens with a poisonous gas. There are, however, very many holdings where, if fumigation alone were employed, very little headway would be made in checking the pest; not ten per cent. would be affected by fumigation, because in such cases most of the rabbits are not living in burrows but in hollow logs, in rocky outcrops and other forms of cover, and in such places poisoning should always be undertaken in conjunction with any fumigation that is done. All known recommended methods need to be employed to get maximum results.

In districts where rabbits are newly making their presence felt, there are those who flatly refuse to lay poison. If the pest can be dealt with by any other method, such persons should be allowed to do their best, but if their efforts are not effective on no account should their properties be allowed to become a menace to the district and to their neighbours who have adopted all methods with success.

In large open cleared areas, such as obtain in parts of the Eastern wheat belt, fumigation alone might yield good results, but along the Avon Valley or any other parts of the State in which there are many small cleared areas, with timber and scrub-covered hill tops and granite outcrops affording abundant cover, fumigation is not the best method to adopt.

Of course, there will always be a difference of opinion as to which is the best type of fumigating machine or material to use. Every maker deems his own machine effective and naturally thinks it the best, or perhaps the cheapest to operate. All machines will give results; some, however, are much more satisfactory than others. Experience has proved that those machines that give off a definitely poisonous gas are the most reliable, and because of this, chemical fumigators have largely taken the place of many of the older types which were not so sure in their action. Unless a machine generates a gas of a poisonous nature it cannot be honestly recommended. Many machines using fire are effective in the smaller and shallower type of burrows, and here death may be due to either excessive heat or suffocation, but in a short space of time both the heat and the suffocating features cease; but not so, however, with the deadly poisonous gas, and anything coming into its presence must succumb.

Of the chemical fumes, those given off from carbon-bisulphide, and from the various calcium cyanide preparations, are deadly and can always be recommended as sure.

Of the fumes generated by fire, carbon monoxide is the most deadly, and charcoal burning machines, which more readily generate this gas are the best, but conditions must be just right in order to generate the monoxide. Appliances generating smoke, and using sulphur, saltpetre, and other preparations to increase effectiveness are not consistently successful, and therefore cannot be recommended as the majority of them fail in the large and deep warrens. With every machine a great deal depends on the human element, and a brief review of the action of the various methods and gases will enable users to apply any method intelligently.

Care needs to be exercised when pumping in the fumes as it will be often found that there are some burrows that are evidently not connected with the others, and need separate treatment. Before starting to fumigate it is a good practice to go round the neighbourhood with a dog or two and drive in all the rabbits that are lying out.

Carbon-bisulphide gives off a gas which is two and a half times heavier than air, and when pumped into burrows the gas naturally sinks to the lower levels and every corner of the warren. On this account it is eminently suitable for fumigating and especially so for fumigating deep burrows. When the inmates of a burrow are disturbed by fumigating operations, etc., they naturally go to the lowermost portions, and being frightened, remain there for a considerable time, thus the heavy carbon-bisulphide gas sinks and reaches them before they have time to recover from their fright. A further advantage of carbon-bisulphide is that being heavier than the atmosphere, it remains below, and should the warrens be opened up from the outside it does not readily escape as lighter gases would. Care needs to be exercised that sufficient gas is pumped in, otherwise only the lowest levels will effectively be poisoned. From various reports, the non-success with carbon-bisulphide is found to be due to insufficient gas being applied. A simple method of ascertaining whether sufficient gas has been applied is to smell at the various openings. If the gas is rising it is obvious that it has displaced the air and the burrow is full of gas. A warren of, say, fifteen openings will require ten to fifteen minutes' treatment. As the fumes are highly explosive, smoking or striking matches should be strictly avoided.

When using it, care should also be taken not to inhale the fumes, as, though not readily fatal to man, it nevertheless depresses the vital powers, and may cause headache or vomiting. In handling it, the person doing so should always stand on the windward side of it.

Many I find resort to the practice of throwing a lighted match down the burrow, exploding the carbon-bisulphide fumes. This, however, is totally unnecessary, the carbon fumes being heavier than air remain in the lower part of the burrow, whereas when exploded they escape, and besides it is a dangerous practice.

The gases are no more poisonous than the original carbon fumes; what is produced is carbon dioxide, carbon monoxide, and sulphur dioxide, all of themselves poisonous, but the volume of gas produced by the explosion is threefold. Therefore, a considerable amount escapes, and if any good is to result the mouth of the burrow must be immediately well tamped with earth. The practice, however, is not to be recommended, as besides being dangerous, it is not economical.

Carbon-bisulphide should be stored in a shed, or put in a hole underground, and covered over with boughs to keep it cool.

It can be used in all weathers and in many descriptions of country, and is never found to fail, if properly handled; but it should be under strict supervision, for it is very explosive. No fire must be allowed near it, either in carrying, using, or storing it. This must be kept constantly in mind. Its exposure to heat should be avoided.

If a machine is not used, cotton waste or bagging can be saturated with the carbon liquid and thrust as far into the burrow as possible. Close the entrance, taking care not to cover the bagging in the process. This practice, however, is not an economical method of applying carbon bi-sulphide.

After a day's fumigation with carbon bi-sulphide, pour back into the air-tight drum any bisulphide of carbon left in the machine and withdraw the plunger and stand it and also the leather collar washer of the machine in neatsfoot or harness oil as, if this is neglected, both will quickly perish and the machine be rendered useless until new ones are obtained.

Cyanide for fumigation purposes is put up in various forms. One firm prepares it in dust form, another in briquettes, and it is blown through the warrens by machines. The resultant gas is known as hydro-cyanic-acid gas, and is extremely deadly to all animate life. On this account it is wise to keep on the windward side when using it. The gas is lighter than air, and therefore, tends to remain in the upper tunnels, and is given off more readily when in contact with moist earth than when in a dry state. When blown into a burrow, being light, it naturally follows the line of least resistance and is forced along the higher levels and does not so readily reach the lower levels as is the case with carbon-bisulphide. Because the gases as given off keep to the upper levels, it is absolutely essential that each opening should be tightly rammed when being filled in. If this is not done the gas will escape. This applies to all lighter-than-air gases.

When digging out burrows fumigated with this gas, the dead rabbits are invariably found near the surface, which goes to show that the poisonous fumes do not reach the lower levels, but that the rabbits on recovering from their fright have come up from the lower levels into the cavities where the gas has remained, and have there succumbed.

Many, however, may have remained in the lower levels and if the burrow is opened up from the outside the gas will escape, as also will the live rabbits that are inside. Even if the burrows are not opened, live rabbits in dead ends may dig their way out and so avoid passing through the gas-filled channels.

As both carbon-bisulphide and cyanide preparations are costly, a deal of waste can be avoided by filling in all burrows a couple of days beforehand. By this means only the live burrows will need treatment and in loose sandy country it will be found that very many of the warrens will not be re-opened at all, especially if the earth is heaped up over the opening when enclosing, as in digging out the rabbit more often than not becomes buried by the falling in of the loose earth.

Of the fumes generated by fire, carbon monoxide is the most deadly, but unless the conditions are right, monoxide will not be produced. In order to produce carbon monoxide from charcoal, a compact mass of glowing coal through which the air is drawn is essential.

There are one or two very good machines on the market that are giving good results when instructions are implicitly followed, but if leaves, roots, etc., are used instead of charcoal, they will not give off the necessary poisonous gas. These machines naturally are not quite so handy for moving about as the chemical machines, but they have this advantage in that the first cost is practically the only one. Charcoal can be readily obtained on any farm, whereas chemicals cost a considerable sum. The exhaust fumes from a motor car, truck, etc., give off a proportion of monoxide gas, but the use of motor cars or trucks for fumigating rabbit warrens is not an economical proposition; it is like employing an 18-pounder with which to shoot a sparrow.

With machines burning leaves and rubbish, sulphur and other chemicals are sometimes added to make them more effective. As the fumes are pumped in hot they naturally remain in the upper levels and there is a risk that insufficient dioxide will be generated to reach the lower levels and be effective in deep burrows.

The use of this type of machine has been found successful in the shallow type of warren and death may be due either to suffocation or to the high temperature produced. One point to remember with this class of machine is that in order to achieve success the fumes must be pumped into a burrow for a considerable time. If pumping is only conducted for a few minutes many of the burrows if opened next day will be found to contain live rabbits, even though treated for fifteen or twenty minutes. Powders are also supplied by some manufacturers for use with their machines. They are comprised of arsenic or such like materials for generating a poisonous gas. These gases are also effective but generally of the lighter than air variety, and the powder preparations so essential to their success are a continual source of expense.

There are a number of smoke machines on the market. The smoke itself will not kill readily, but even if the smoke is not effective the pumping of hot air into a small space, if continued long enough, will have the desired effect, at any rate in comparatively small and shallow burrows.

Generally speaking, smoke appliances are not much in vogue to-day. They have given place to the surer and generally more economical (judged by results) types of chemical fumigators, or those that are known to give off definite poisonous gases.

I would again stress the fact that fumigation is only effective as a method of destruction where there are plenty of burrows and warrens. In this State with its sparsely cleared areas affording abundance of cover, rabbits are not all in burrows. In many districts rabbits are plentiful, yet a warren is rarely seen. Consequently, in conjunction with fumigation, poisoning should always be undertaken. This point cannot be stressed too strongly because even when conditions are highly favourable for fumigation there will still be a large percentage above ground for which poison should be laid, and it has been found a good practice to place a few baits around and on top of each covered-in burrow.

DIGGING OUT.

While this appears to be a simple matter requiring no points, yet there are several that may be emphasised. There is no doubt that it is *the* thing in rabbit destruction, where it can be done; and yet the experience is that it is one of the easiest things to slum by careless workmen. It is easy to miss little runs or side burrows. If the land-owner goes over the filled-in burrows the next day and finds any clean cut holes with the soil scratched backwards, he will realise that rabbits are being missed. No burrow or warren should be left partly finished over night. If so, nearly all the rabbits—barring, perhaps, the little ones—will clear out before next day. Any one who has had a perfectly secure wire-netted paddock dug out, knows that the biggest catches are made in the last day or two. Now, when a paddock is not so netted, a very good plan to adopt is to do a day's digging on, say, the north-east corner, the next day the south-east corner, and then the other corners, and so on, putting in several days before coming back to the starting point. The rabbit is so innately suspicious and "knowledgable" that many will clear out of the burrows next to where the overnight work has been finished, but they will drift back again to those burrows when they find that things are quiet again. By doing this all round a paddock and finally finishing with the central burrows, the best of results will ensue. Even if the occupants of these last burrows are unsettled, they are less likely to go, because all round them has been attended and does not offer much harbour. I have followed this principle with much success. In cases where a property is bad with rabbits, burrows, and harbour, I would strongly recommend a real good poisoning *first*, and then follow up with the other means. In cases where a place is *securely* wire-netted either may do; still, I think that a good poisoning first is always better.

Burrows should not be left open after digging out, but should be levelled off, and, if the time of the year suits, be sown with grasses. This is not only a good thing in itself, but it destroys all evidence of burrows, and any rabbits that may come later are very likely to try to make fresh ones, and, in consequence, are slower in making their homes.

Good practical men can fill in the greater portion of the burrows behind them as they go along, leaving very little to do at the finish. On the other hand, if the open trenches and dirt heaps are left, there is the direct invitation to the rabbit to make a fresh start.

Dogs play an important part and are of the greatest value when digging out is undertaken. A good pack is essential to effectively deal with those that get out and once on the surface the rabbit is done. Digging out is costly and is usually undertaken on land such as permanent pastures, and the landholder would be well advised to sow grass after the ground is levelled. The work could be done more cheaply by using fumigation machines, and this is recommended for farm lands where constant cultivating and fallowing is done.

If warrens are ploughed or dug to a reasonable depth, this is all that is necessary, but it is highly advisable that they should be carefully watched and any openings found dealt with either by fumigating or even trapping with the view to catching the last one. This is a most necessary auxiliary to the digging out process.

WIRE NETTING.

Rabbit fencing is the first line of defence; in fact, the only effective method of dealing with the rabbits on a holding is by rabbit netting the boundary. It enables satisfactory work to be effected inside. Once a property is netted, there should be very little difficulty in getting rid of the pest.

It is a waste of money to erect a fence and not properly look after it. Therefore, it is essential to maintain it rabbit proof. It requires constant and regular looking after. A hole in the netting, a burrow under the fence or a badly fitting gate at once nullifies its utility. Unfortunately, hundreds of instances of neglect are noticed, thus the purpose for which the netting was erected is practically destroyed.

Boundary fences should be the first undertaken, and then subdivisions. If the area is a large one, it will be found that as fast as the pest is dealt with in one portion, they appear to be continually following in your tracks. This, of course, is unsatisfactory and it will be found a constant and expensive job. In fact, they might even increase if the area is, say, as large as 10,000 acres, whereas, if confined to areas of not larger than 1,000 acres—even smaller would be better—it is possible to effectively wipe them out.

Nor is it sufficient to deal merely with the rabbits inside. Watch for burrows forming outside adjacent to the fence line. See they are not allowed to become established and if the fence line is kept clear on either side and frequently patrolled, burrows under the fence will be reduced to a minimum.

Reinfestation of a holding quickly occurs once the fence is neglected; one hole will let in hundreds.

Thoroughness is essential, whether in fencing, poisoning or dealing with the burrows. It all means time but there is no time worth spending on anything else, once the rabbit gets proper control.

Next to wire netting holdings in the dry districts, the netting in of the dams or water supplies will be found most effectual and the rabbits can be destroyed either by poisoned water or by turning the dams into rabbit traps. When the dam

is fenced in, funnels should be put in on each side so that the rabbits can get in but cannot get out. The funnels are made of rabbit netting and should be about 18 inches long and six inches wide at one end and four inches at the other. They are simply made: cut a piece of netting 21 inches long and 20 inches at one end and 14 inches at the other, roll the netting up and allow two inch lap and make it fast in that shape. You have then a cylinder, or, as it is usually termed, a funnel. Cut a round hole in the rabbit-proof fence six inches in diameter, the lower edge slightly below the level of the ground. Then fasten the wide end of the funnel securely round the hole in the fence, with the rest of the funnel projecting into the enclosure; the rabbits can then get in but they cannot get out. A wing a few yards long with netting on it at an angle of about 45 degrees leading up to the openings into the dam will help to guide the rabbits in.

A small yard in one corner of the inside of the fence should be put up and netted over so that the rabbits could be driven into it and killed. Funnels should be used in it also to keep the rabbits from getting out. In dry districts almost every rabbit for a mile or more round can be got by this method.

Netting the whole of the holding must be undertaken sooner or later: in fact, a farmer cannot afford not to net. To fence a 1,000 acres farm requires about five miles of netting. This can be obtained from the Lands Department under the Commonwealth Scheme on very easy terms. The price is approximately £40 per mile or £200 for 1,000 acres.

Repayment is made on easy terms, 25 years, which carries interest and sinking fund. If a farmer loses 15 acres of crop, with its possible yield of 13 bushels, the amount at 3s. per bushel would total £29, whereas the repayment on the netting, including sinking fund, is only £14, thus an amount of £15 is saved. In addition the owner of a netted area has the following advantages:—

1. No local Vermin Rate to pay.
2. A valuable asset and less poisoning.
3. Increased carrying capacity.
4. Better fence for all kinds of stock.
5. No more killing a neighbour's rabbits.

ANTS.

In some places the red ants are very troublesome, but they can very easily be completely cleared out by the following method: Procure some carbon bi-sulphide and after dark go to the nest and put about a dessert spoonful into each hole, closing tightly up after putting the chemical in. If every hole is carefully treated that ought to be the last of that ant bed. A light will be necessary to see the small holes, and in all cases a covered light should be used, and even then it should not be brought too near the carbon, which is very explosive.

Other kinds of ants may be got rid of by putting the carbon bi-sulphide into their holes wherever found and immediately closing them up.

Arsenical sheep-dip powders are useful for keeping small black ants in check if sprinkled about their nests or runs.

The ordinary rabbit poisons mixed with water in the proportion of one part to 40 of water and poured into the nests immediately after mixing will destroy great numbers of them.

Small black ants can be destroyed by finding their nests and pouring a kettle of boiling water into them.

PARROTS.

The following method of poisoning parrots is said to have proved very successful, finely ground strychnine being used:—

One or more apple trees, of a variety most favoured by the parrots—preferably in different parts of the orchard—are selected. All the apples are picked. A good number, say half a case, of attractive, firm juicy apples are then taken, and, with a packing needle, a string is run through them individually from stem to calyx, leaving a couple of inches protruding at each end. With a pen-knife an incision is made in the side of the fruit (more than one if the fruit is large), inserting the blade almost to the core, and giving it a turn so as to take out a "plug" a little less than half an inch across. Into the hole thus made a small quantity of strychnine is placed, about as much as will stay on the point of the knife blade. (A reversed pen nib will be found to meet the case.) The "plug" is re-inserted, and the apples are allowed to stand at least twelve hours, by which time the peculiar solvent juices of the apples have carried the strychnine throughout the fruit.

To hang the fruit in the chosen trees is the next thing. For this purpose, nothing is found to act better than a bough from a gum tree, which is then mounted on a pole so as to be well above the foliage of the apple tree. This is preferable to hanging the fruit on the tree itself, inasmuch as parrots generally alight on the topmost part of the tree and work downwards. The boughs are also portable, and, should the parrots shift their quarters to another part of the orchard, can easily be removed to the spot. The best plan is to place a number of boughs in different parts of the orchard. It is scarcely necessary to say that every care must be taken to warn persons going into the orchard. Poultry should also be kept at a distance, though little fruit falls from the boughs, on account of its being tied on. In the case of parrots, put a couple of decoy birds in a cage in the tree, and the parrots can be left to their own devices.

The poison is exceptionally quick in action, and in ten minutes or so from the time they commence to eat, the birds will begin to drop. Many fly away as soon as poison pangs seize them, and may be found in all parts of the orchard, as well as the bush around and in the neighbouring orchards. Poisoned birds have been picked up five miles and more away. This fact makes it impossible to compute definitely the extent of the destruction, but enough can be gathered from known results to show that the method is exceedingly effective. As the poisoned fruit is eaten, more is put up, and the work may be continued almost indefinitely while the birds continue to give trouble.

Wheat poisoned with strychnine (see No. 2 recipe) is also very effective for baiting parrots.

SPARROWS.

Although so far as is known sparrows have not yet made their appearance in West Australia, we may at any time hear of them having crossed the border. Should any appear a report should be sent to the Agricultural Department at once. Sparrows are usually destroyed by poisoned grain, but they are very cunning, and the first time poisoned grain is used excellent results are generally obtained, but after that it is difficult to get them to take it again. This may to a considerable extent be overcome by mixing the poisoned grain with horse droppings where they fall.

Next to rabbits, sparrows are probably the most serious pest than the wheat farmer would have to contend with once they established themselves here, hence the necessity of preventing them getting a footing, and of immediately reporting their presence.

RATS.

In some places, especially in the towns, rats do an enormous amount of damage.

If the holes are in the ground they can be destroyed by stopping up any holes connecting and putting some carbon bi-sulphide on a piece of waste or rag and pushing it as far as possible into the hole and securely stopping it up.

Care should be taken to leave no garbage about, and as little food as possible. If there is no food the rats will not remain.

Poisoning.—The following poisons are recommended by the Rat Department of the United Kingdom:—

1.	Barium carbonate	6 ozs.
	Oatmeal	16 ozs.
	Dripping	4 ozs.
	Salt	½ oz.

This will make about 1,000 baits, each piece about the size of a small marble.

2.	Barium carbonate	4 ozs.
	Biscuit or oatmeal	4 ozs.
	Oil of aniseed	5 drops.

Mix with fat to a paste and lay out in pieces size of a small marble where the rats are known to be.

3. Tallow and Carbonate of Barium in equal proportions.

Mix with dripping to a thick paste and spread on hot toast; put small pieces about.

Doctor Howarth, Medical Officer of the City of London, recommends varnish as one of the most effective methods of getting rid of rats that are difficult to trap or poison. The substance used is strong lithographic varnish. It should be warmed by heating the container holding it in boiling water; when warm, the varnish will run, and in this condition it should be spread one-sixteenth to one-eighth of an inch thick on pieces of fairly thick cardboard measuring about 15in. by 12in. A margin of about an inch should be left clear all round and the bait placed in the centre of the board. The traps should be placed near where the rats run. The varnish will remain effective for about 4 days, and to renew, the old varnish should be scraped off and fresh applied.

Good bird lime on strong brown paper has also been found effective.

ANTIDOTES FOR POISONING.

FOR HUMAN BEINGS.

In case of human beings poisoned by rabbit poison, the symptoms and necessary remedial action are described by the Commissioner of Public Health, Dr. Atkinson, as follows:—

Phosphorus Poisoning.

Symptoms of poisoning by phosphorus may occur in two stages, as follows:—

A few hours after taking there is a taste of garlic in the mouth; there is a burning pain in the stomach, with vomiting of blood (green or black) and the vomit has a garlic-like odour; there is a swelling of the abdomen. The patient may die in this stage or apparently recover, when, after two or three days intense jaundice appears, with great prostration and collapse, and finally unconsciousness and death.

The best antidote in the earliest stages of poisoning is Copper Sulphate (Bluestone).

Three grains dissolved in about four ounces of water should be given every five minutes until vomiting is induced, then every fifteen to thirty minutes. Also *old or French Turpentine* may be given in forty-drop doses in one ounce of water every quarter-hour for one hour, and then thrice daily. *American or German Turpentine must be avoided. Oils and fats must be particularly avoided.*

Strychnine Poisoning.

The symptoms of strychnine poisoning may come on very soon after taking. There is a feeling of suffocation and lividity of the face. Violent convulsions, with spasms of the muscles coming on at intervals with arching of the spine backwards, is the outstanding sign of strychnine poisoning, though this occurs also in tetanus. An emetic should be immediately given in the endeavour to rid the stomach of any poison that remains in that organ.

Vomiting may be induced by administering any of the following:—

Mustard Powder.—A tablespoonful in a tumbler of warm water.

Common Salt.—Two tablespoonfuls in a tumbler of water.

Zinc Sulphate.—Thirty grains in half a tumbler of water, or

Copper Sulphate (Bluestone).—Five grains in half a tumbler of water.

If none of these remedies are available, then copious draughts of warm water may have the desired effect.

Antidotes to strychnine are:—

Tannin.—20 to 40 grains in two ounces of water.

Tincture of Iodine.—A half-teaspoonful in half a tumbler of water, followed by an emetic.

Chloroform should be inhaled to control the convulsions.

FOR STOCK.

The Chief Inspector of Stock recommends the following:—

The antidotes for phosphorus poisoning are Turpentine and Sulphate of Copper (Bluestone). The doses of the former are:—

1 ounce for Horses and Cattle.
2 drams for Sheep and Pigs.

The doses of Sulphate of Copper (Bluestone) are:—

1½ drams for Horses.
2 drams for Cattle.
25 grains for Sheep.
8 grains for Pigs.

These may be mixed and given as a drench in a little water.

As an antidote for strychnine poisoning, Chloral may be given, the doses being:—

1 ounce for Horses.
1½ ounces for Cattle.
1 dram each for Sheep and Pigs.

This can be given mixed with a little milk.

The following treatment is described by the Government Analyst, Mr. Mann, as being efficacious in the cases of *live stock* suffering from either phosphorus or strychnine poisoning, and this is given out for the information of settlers in addition to that described by Mr. Weir:—

The use of Permanganate of Potash Tabloids.—These are manufactured by Messrs. Felton, Grimwale & Bickford, of Perth, and local storekeepers ought to stock them. The following doses are suggested, and they may be exceeded with safety:—

For Sheep: 1 tabloid.
For Pigs: 1 tabloid.
For Horses: 2 tabloids or more, according to size.
For cattle: 3 to 5 tabloids, according to size.

If within half-an-hour after the first dose the animal does not seem to improve, another dose of half as much as formerly may be given, and if necessary, repeat the dose once or twice later on.

Table of Equivalent Quantities.

3 grains = cover sixpenny piece.
15 grains = heaped sixpenny piece.
6 grains = cover shilling piece.
21 grains = heaped shilling piece.
1 drachm = 1 teaspoonful level.
¼ ounce = 1 dessertspoonful level.
½ ounce = 1 tablespoonful level.

NITROGEN ON STUBBLE TRIALS.

I. THOMAS,
Superintendent of Wheat Farms.

With the object of determining whether an application of a nitrogenous fertiliser, in the form of sulphate of ammonia, in addition to superphosphate, is profitable when applied to an oaten hay crop planted on land which has grown a cereal crop the previous year, a series of field trials was conducted in conjunction with Messrs. Cuming Smith & Mt. Lyell Farmers' Fertilisers Ltd. and Nitrogen Fertilisers Ltd. during 1935. These trials were conducted in the Victoria and Great Southern Districts.

To meet the requirement of the experiment, three plots representing three treatments were required. These were repeated three times, making a total of nine plots. In each section all three plots received an application of 112 lbs. of 22 per cent. superphosphate per acre. The centre plot in each section received no application of sulphate of ammonia and was treated as the control plot, and was compared with the remaining two plots which received ½ and 1 cwt., respectively, of sulphate of ammonia.

Planted under field conditions, each plot was one drill width wide and one-tenth of an acre in area.

The collaborating officer associated with the trial in the Victoria District was Mr. G. L. Throssell, Agricultural Adviser, and for those in the Great Southern area, Mr. A. S. Wild, Senior Agricultural Adviser. In carrying out both series of experiments, the fertiliser companies were represented by Mr. G. N. Lowe.

The reports and results obtained from the respective districts are as follow:—

VICTORIA DISTRICT.

G. L. Throssell, Agricultural Adviser.

The sites of the trials in this area were located as follow:—

Coorow—I. B. Roberts. Soil—medium red to sandy loam. Timber—salmon and york gum.

Carnamah—J. K. Forrester. Soil—sand-plain. Timber—stunted scrub.

Geraldton—F. J. Horwood. Soil—red clay loam. Timber—york gum.

The rainfall recorded at these centres is shown below:—

Place.	Growing Period.										Total, May to Oct.	Total Jan. to Oct.
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.		
Coorow	70	17	28	124	64	153	171	291	92	18	789	1,028
Carnamah ...	107	41	88	191	80	182	223	318	79	7	809	1,316
Geraldton ...	89	26	111	365	78	248	321	339	84	64	1,056	1,723

The variety "Mulga" was planted in each case at the rate of 50 lbs. per acre. The hay yields obtained from the trials are tabulated below.

RESULTS.

Quantity of Sulphate of Ammonia per acre.	Average Yield per Acre —Three Plots. (cwts.)	Per cent. Yield	Increase due to Sulphate of Ammonia at £12 per ton. (cwts.)	Cost of Sulphate of Ammonia at £12 per ton.	Value of Increased Hay at 50/- per ton.	Increased or Decreased Returns per acre.
	Planted 9th May.			J. B. Roberts, Coorow		
56lb.	24·0	109	2·0	6/-	5/-	Loss 1/-
Nil	22·0	100	...	...	...	...
112lb.	27·4	125	5·4	12/-	13/6	Profit 1/6
	Planted 7th May.			J. K. Forrester, Carnamah.		
56lb.	17·4	109	1·4	6/-	3/6	Loss 2/6
Nil	16·0	100	...	...	...	...
112lb.	20·4	128	4·4	12/-	11/-	Loss 1/-
	Planted 30th May.			F. J. Horwood, Geraldton.		
56lb.	32·8	105	1·6	6/-	4/-	Loss 2/-
Nil	31·2	100	...	...	...	...
112lb.	32·1	103	0·9	12/-	2/3	Loss 9/9

The applications of sulphate of ammonia in every case resulted in increased yields per acre, but in only one case did this increase, assessed financially, result in a profit and then at the rate of but 1s. 6d. per acre.

GREAT SOUTHERN DISTRICTS.

A. S. Wild, Senior Agricultural Adviser.

The sites of the trials in this district were located as follow:—

Pingelly—W. O. Sewell, 4 miles west of Pingelly. Medium sandy loam. Jam timber.

Katanning—Ball Bros., 4 miles south-west of Katanning. Medium sandy loam. York and white gums, jam and sheoak timber.

Gnowangerup—J. McDonald, 1 mile south-east of Gnowangerup. Red clay loam. York and salmon gum timber.

Gnowangerup—R. M. Watterson, 4 miles north of Gnowangerup. Light sandy soil. Mallee and scrub timber.

The monthly rainfalls, as recorded at the centres where the experiments were conducted, are given below:—

Centre.	Jan.	Feb.	Mar.	Apl.	Growing Period							Total, Jan. to Oct.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.	
Pingelly	29	85	6	90	136	195	396	264	195	393	1,579	1,798
Katanning ...	42	82	4	147	191	256	394	234	223	110	1,408	1,683
Ball Bros. ...	23	91	2	106	191	215	430	198	210	141	1,385	1,607
Gnowangerup ...	51	48	...	89	87	176	306	202	149	132	1,052	1,240

The following are the results of the hay yields computed as cured hay, obtained from the trials:—

RESULTS.

Quantity of Sulphate of Ammonia per acre.	Average Yield per Acre —Three Plots. (cwts.)	Per cent. Yield.	Increase due to Sulphate of Ammonia at £12 per ton. (cwts.)	Cost of Sulphate of Ammonia at £12 per ton.	Value of Increased Hay at 50/- per ton.	Increased or Decreased Returns per acre.
	Planted 16th May.			W. O. Sewell, Pingelly.		
56lb.	18·8	152	6·4	6/-	16/-	Gain 10/-
Nil	12·4	100	...	...	...	...
112lb.	27·2	220	14·8	12/-	37/-	Gain 25/-
	Planted 5th April.			Ball Bros., Katanning.		
56lb.	20·1	142	6·0	6/-	15/-	Gain 9/-
Nil	14·1	100	...	...	...	...
112lb.	32·7	231	18·6	12/-	46/6	Gain 34/6
	Planted 14th May.			J. McDonald, Gnowangerup.		
70lb.	26·5	123	5·0	7/6	12/6	Gain 5/-
Nil	21·5	100	...	...	...	...
140lb.	28·3	132	6·8	15/-	17/-	Gain 2/-
	Planted 3rd April.			R. M. Watterson, Gnowangerup.		
56lb.	8·4	221	4·6	6/-	11/6	Gain 5/6
Nil	3·8	100	...	...	...	...
112lb.	12·9	339	9·1	12/-	22/9	Gain 10·9

With the exception of the plots at Pingelly, which were planted with the variety "Mulga" at 60 lbs. per acre, all plots were planted with "Algerian" at 56 lbs. per acre.

The results of all trials in the Great Southern Districts during this the first year of the experiment show substantial increases of oaten hay yields by applying sulphate of ammonia in addition to the superphosphate. In each case the increase would be profitable. On the light sandy land of Mr. Watterson's trials the application of 56 lbs. of sulphate of ammonia increases the yield 121 per cent., this increase being doubled to 239 per cent. when the amount of nitrogenous fertiliser is doubled to 112 lbs. per acre.

On the medium types of soil at Pingelly and Katanning this increase of fertiliser increases the yield in a much greater proportion, but on Mr. McDonald's heavy land the extra sulphate of ammonia does not increase the yield to the same extent as the first 70 lbs. per acre.

The increases in the hay yield obtained on Mr. Watterson's light land indicate the application of the nitrogenous fertiliser to be profitable, but the level of production is so low that the total return would not show a profit over the total cost of obtaining the crop.

In addition to the main object of the experiment, viz., the comparison of the yields, the following field observations were made:—

(1) The clover growth on the plots which received superphosphate only was very much greater than on the plots treated with sulphate of ammonia and superphosphate.

(2) Where "tipping" of the heads of the oat crop occurred, there appeared to be more of this condition on the sulphate of ammonia plots.

(3) The maturity of the oats was hastened by the application of sulphate of ammonia.

"AND FIERCE DISEASES WAIT AROUND."

Geo. W. Wickens.
Superintendent of Horticulture.

When discussing disabilities common to the lot of the primary producer—"weather," "markets," "freights," etc., etc.—apple growers in Western Australia are wont to murmur a prayer of thanksgiving that at any rate two of the worst scourges of the apple industry, viz., "Codlin Moth" and "Apple Scab" are not amongst the enemies they need to wage war against in this most favoured State. What this means in peace of mind and saving of cash only those who have battled with them truly realise, and many of our fruitgrowing friends on the eastern side of Australia find a difficulty in believing that a pest and a disease, each so common in their orchards, can be non-existent on the western side. But that freedom is not the result of accident, and I am writing these notes to warn growers that both these undesirable immigrants are with us at the present time, and the only way in which they have been stamped out in the past, and can be stamped out again in the future, is by finding them in their early stages when rigorous measures can be adopted over small areas that would be almost impossible were they widespread throughout the orchards of the State.

Codlin Moth was found in Ewington, near Collie, last summer, too late in the season to carry out a spray programme: but an intensive search of the trees in the infected orchards by officers of the Department, and killing by hand of all caterpillars found under the rough bark, or in broken limbs, had an excellent effect in controlling the pest, and this, followed by a thorough spraying of the whole area during the early part of the present summer has been so successful that it is a very difficult matter indeed to find an infected fruit: in fact, a ten days' search by two departmental officers failed to reveal one apple with codlin larvae inside, and there is every reason for believing that next year's operations will finalise the work, and the codlin.

A more disturbing circumstance even than the appearance of codlin is the outbreak of Apple Scab, *Fusicladium dendriticum*, in an orchard at Manjimup, and though I have no doubt the fight against it will be successful it will not be an easy, nor an inexpensive one to the grower concerned. Had the scab secured an unrestricted run this season it is almost certain that more orchards would have shown infection next year, and with such a virulent and insidious disease the time when eradication can be undertaken is soon passed, and then the long and costly fight for control commences with its heavy annual expenditure added on to the loss of fruit. To avoid this I wish again earnestly to impress on all growers the absolute necessity of advising the Department should any unusual symptom on either trees or fruit manifest itself, so that whether the unwelcome stranger is either insect pest or fungus disease it can be scotched before it obtains a firm hold.

COMMON AILMENTS OF POULTRY AND THEIR TREATMENT.

G. D. Shaw,
Poultry Adviser, Department of Agriculture.

Falling Down Behind Prolapsis—is the eversion of the cloaco and oviduct (the tube in which the egg is made). This trouble may affect a whole flock in one or two ways or it may be isolated. If isolated, one can assume a weakened constitution and disregard it, but when the trouble is in epidemic form, one must immediately find the cause. It may be due to one of two troubles—too stimulating a food and cannibalistic habits. If the birds are being fed a forced ration it will be noticed that they may suffer from prolapsis. This is the result of severe straining. The remedy is obvious. Reduce the proportion of stimulating diet—most likely the meatmeal percentage is too high.

The second cause, although resembling prolapsis, may not be due to stimulating foods. Some birds cannot resist picking at blood or red-coloured flesh.

It has been observed that one such bird will parade along the nests and await the laying hen. As soon as the egg is laid, and before the cloaca is withdrawn, this bird will pick it and cause it to bleed. When this bleeding occurs the damaged bird cannot withdraw the cloaca and so the picking continues. Other birds are then attracted to the damaged bird and proceed to pick and eat the exposed flesh. Eventually the bird dies but not before the cannibals have drawn out its intestines and consumed them. This habit spreads so much that many dead birds are found daily, each bird having been cleaned out.

Such an effect causes the bad habit to spread and the only cure is to determine the culprits and kill them off. This is a tedious process, for it is necessary to sit and watch the hens laying until the culprit is found.

The main difference in observation of the two causes of these troubles is that prolapsis proper displays a form which may leave the birds exposing the cloaca; the cannibalistic habit invariably shows dead birds which have had their whole intestines withdrawn from the body.

If one is doubtful as to the cause—whether a too stimulating diet or the bad habit, just check up on the ration and if it is such as to cause no alarm, concentrate on the other trouble. One should suggest finally that prolapsis is not epidemic but the habit of picking at the everted cloaca is.

Dropping Abdomen.—A heavy pendulous abdomen may be one of two troubles. If it is heavy and hard one can generally assume that the bird is laying internally. The egg, when ripe, falls into the oviduct, but should the oviduct be misplaced, the eggs will then fall into the abdominal cavity where they accumulate and form into a hard mass of yolk matter. The bird walks in a strange manner, the abdomen low down on the ground as the bird is desirous of laying.

Eventually the bird will die. The cause is generally an accident and no cure is possible.

Abdominal Dropsy on the other hand is a collection of fluid in the peritonial cavity, due to obstructions in the circulation of heart, liver, etc. It is seen mostly in old hens that have been heavy layers. The abdomen is large and hangs down, and when handled it shows an accumulation of fluid. One can treat the bird by opening the abdomen and withdrawing the liquid, but it is a doubtful procedure. It is best to destroy the affected bird.

Fatty Disposition.—This condition is caused by the feeding of fat-forming foods. The symptom is heavy hens, poor laying, and heavy layers of fat in the abdomen. The remedy is obvious. Make the birds work for their food by using deep litter in which to feed the grain. Feed sparingly on wheat and see that the ration contains a proper proportion of meatmeal.

Heavy birds are prone to over-fatness and for that reason they must have a higher proportion of protein in their ration when compared to light breeds which are more active and can utilise more carbohydrates.

Feather Eating.—Another bad habit is feather pulling. It is generally induced through a lack of something in the ration or, again, by idleness. Lice-infected birds may acquire the habit. With lice the birds may cause blood to flow, and the other birds then resort to cannibalism. This habit seldom occurs in flocks well fed and housed.

Feather Lice.—There are several varieties of feather lice, but for the purpose of this article they will not be discussed in detail. These lice invade the feathers of the bird and the noticeable symptom is a bird raking the feathers during the day. By examining the bird one can see these lice running on the skin between the feathers, most prevalent just above the vent. Several cases of heavily infested birds have brought to our notice a skin trouble which disappeared with the eradication of the lice. It is a trouble very easy to remedy. Sulphate of nicotine (black leaf 40) when placed on the perches, immediately before roosting time, will give instantaneous relief. The fumes arising from the nicotine invade the feathers and kill the lice. Only a thin line of nicotine is required.

Eggs.

Egg Binding.—This is not very common, but does occur within a flock. The affected bird is noticed visiting the nest frequently without result. It walks with a lowered abdomen and tail, generally with a look of discomfort. After the bird has been on a nest for a fair time and no egg is passed, pour into the vent a dessertspoonful of olive oil; this may give relief.

Another method is to hold the bird over a bowl of hot water for about 15 minutes. If the bird does not respond to these treatments, it is then necessary to insert the forefinger and remove the egg by gentle working. Smear the finger with vaseline and take great care not to break the egg. If by any chance the egg is broken, all particles of shell must be removed; otherwise the bird will die.

Doubled Yolked Eggs.—This abnormality is the result of the falling of two yolks into the oviduct and being encased in the one shell. Pullets which have been reared properly have a tendency to lay a fair quantity of double yolked eggs when coming into their first lay. This will most likely right itself when they settle down to steady laying. If they do not correct the fault, the ration is too stimulating and will be accompanied by bloodspots inside the shell. A continued laying of double yolked eggs will eventually cause the death of the bird, due to internal straining.

Miniature eggs are due to some irritation at that spot in the oviduct which secretes the albumen. The irritation causes an excessive flow of albumen and as it passes down the oviduct it is encased in shell and passed through to the nest. Sometimes these eggs contain blood, showing that the oviduct is damaged. Of course, small eggs may be seen at the end of a laying period.

Shell-less eggs or thin-shelled eggs are due to lack of calcareous material. Soft-shelled eggs may be due to the expulsion of the egg before it has had time to be properly covered, while thin-shelled eggs definitely denote lack of shell-form-

ing material in the constitution. This may be due to one or two causes. Firstly, lack of shellgrit, and, secondly, a lack of constitution, not allowing the bird to assimilate that shellgrit and manufacture it into its proper material for secretion on the egg.

A plentiful supply of shellgrit will assure properly shelled eggs, but if the supply is sufficient, and thin-shelled eggs still persist, one can look for a run-down condition of the flock. Give an iron tonic and so remedy the trouble.

Blood Spots—(i) on the yolk; (ii) in the white.

(i) When the yolk has grown to full size and is ripe, ready to be released by the ovary, the yolk sac parts and allows the yolk to fall into the oviduct. If, for any reason, the yolks are ripening too fast, such as may be due to a very stimulating diet, the yolk sac may be strained and the miniature blood vessels are damaged, causing a blood flow to fall also into the oviduct, on to the yolk. As the yolk then passes down the oviduct it is first covered with a thick albumen, and so the blood is encased next to the yolk. Further coverings of albumen keep that blood spot close to the yolk and we have an egg laid which contains a blood spot caused through feeding a too stimulating diet such as excessive meatmeal in the ration.

(ii) Should the blood be in the albumen or white of an egg, we can assume that there is a bleeding somewhere down the oviduct before the egg is shelled. This bleeding may be caused through a damaged oviduct due to accident or over-fatness.

It is necessary to keep the two positions defined because the causes of each are so wide apart. A too stimulating diet and over-fatness must be corrected differently, so one must definitely decide from whence the blood is coming. If it were because of a too stimulating diet, it would be disastrous if one thought it to be due to over-fatness and vice versa.

Both these blood spots may be separated from an egg after it is broken. Such eggs are not harmful but in order to eliminate them from consumption, the eggs must be tested in front of lamps before sale. The spots may vary in size.

If the spots are on the yolk, reduce the meatmal in the ration. If in the white, or albumen, look to the cause and remedy it. Should the bird be over fat, give a ration containing more meatmeal and skim milk, and plenty of exercise.

Misshapen Eggs are due to some restriction in the muscular action of the oviduct or may be through stricture due to over-fatness. All misshapen eggs are not weak in the structure, but it is only by light testing that one can be sure. Some have ridges surrounding them. The causes are not definitely known, but it has been shown that some birds which have continually laid misshapen eggs have produced stock which continued to do so. It is then a constitutional weakness. Always breed from birds which produce the best shaped eggs.

Eggs held up in the oviduct are observed, and in such cases, should the egg be fertile, the result will be the laying of a bad egg. Such cases are rare, but not impossible. One such egg in a consignment causes a lot of damage.

Egg-Eating Habit.—This can develop in a flock of birds to a degree which is appalling. The birds acquire the habit through gaining access to a broken egg in the nest or on the floor. Once a bird learns what an egg contains it develops the practice of breaking the egg. Other birds are taught—the losses grow. When using trapnests, the culprit is found at once, but under the system of open nests one must watch closely until the wrongdoer is isolated. Kill or market that bird.

Apart from the bad habit, the lack of lime-forming material may be a cause. Plenty of shell grit in the nest boxes will assure a supply and at the same time keep the eggs clean. Several suggestions are offered in order to break the habit, but the habit should not be allowed to form. Collect eggs frequently, and see that there is plenty of nesting material and plenty of egg-forming material.

Limberneck or Botulism.—The first sign of this trouble is a dull and listless appearance, dropped wings, loose feathers and loss of power in the neck, loss of strength in wings and legs. The bird is weak—it cannot see properly and its pupils are paralysed. The muscles of the neck are useless—in severe cases death occurs in 36 hours or less. The cause is food poisoning or botulism—through eating unsound food, such as tinned meat or a bone or some other decayed animal matter.

Do not throw to the stock bones which contain meat—if not consumed the meat turns and is a prevalent cause of trouble.

Pneumonia.—Pneumonia is inflammation of the lungs. A cure is difficult as the disease is only evident on post mortem observation. Generally the bird is dead before the disease is suspected. Whenever one notices a bluish comb look for lung trouble. It generally denotes that the bird is not getting sufficient air and may be caused by an obstruction in the windpipe, caused mostly by canker, but it may be either bronchitis or pneumonia. A bird dying of pneumonia is often apparently well one day, but dead the next morning under the perches, with blood showing in the mouth. Remedy the cause, which will generally be damp and draughty houses or changeable weather ailing a bird which has been forced to sleep in a stuffy house.

Roup.—The first system of roup is really chickenpox or fowlpox. It would pay all poultry-keepers to visit their houses after dark. On going among the birds, if one finds a hen "winking" (which is an unnatural procedure in a bird), one can be sure that chickenpox (the forerunner of roup) is coming. At this stage it is easily dealt with. Obtain sixpennyworth of oxide of zinc; the same bulk of flowers of sulphur; mix together with olive oil and lard to a creamy paste. This ointment applied to the affected part of the bird, which will be the eye in this case, is a certain cure.

Should the birds be "running" at the nose, the disease has got a deeper hold. If the bird is worth keeping, syringe the nostrils out with peroxide of hydrogen, using an eye dropper, but making extreme pressure when syringing. This will clear out the nostril. The next stage will be "running" eye and cankerous growth in the mouth. At this stage, it is hardly worth while persevering with individual birds. These birds may be eaten; it would pay to kill them all, but they may be treated.

Lift the cankerous growths with a sharp stick and paint the affected spot with perchloride of iron, taking care that none drops down the throat. Sometimes the cankerous growth is in the windpipe. The pipe must be cleared. This is done with a pointed stick, the bird coughing during the operation. Bleeding must be avoided, and by painting with perchloride of iron the disease will be arrested. Any further complication cannot be dealt with. The bird will usually die before the operator can do anything. On no poultry farm, well managed, should roup get beyond the chickenpox stage. If fowlpox only is prevalent, the treatment with the ointment before mentioned should be effective.

Any eye trouble should be treated by placing one drop of 10 per cent. argyrol in each eye, night and morning, and, should one notice the "winking" symptoms, it would be advisable after treatment with the ointment to put argyrol in each eye.

Roup affects the birds during changeable weather, and in order to prevent its inroads farmers are advised to treat the water with permanganate of potash to the colour of deep claret and, at the same time, put enough kerosene on top of the water to wholly cover it with a film. This treatment should be started early in March and carried through until the end of May.

Red Mite.—This little mite causes enormous losses to the poultry keeper. It is not easily noticed until a pronounced drop in egg production informs the attendant that something is wrong. The normal colour of the mite is grey, but when gorged with blood it is a bright blood red. They live in crevices under perches and nests and at night swarm out and crowd on the bird's body. They suck blood until gorged and before daybreak are hidden away. During hot weather they multiply rapidly and can cause great loss to the farm. They are very small and hard to see, but in clusters can easily be recognised.

Every crack and crevice about the house and all perches and woodwork should be treated with "Flezol" by spraying or painting. Do this at regular intervals. Do not confuse this mite with the red-legged earth mite.

Scaly Leg.—As its name indicates, scaly leg is a disease of the shanks and feet of poultry. The cause is a very small mite which spreads rapidly from one fowl to another. The scales usually occur first on the feet and then on the shanks. After development they form crusts, which are unsightly and painful. The toes may eventually fall off.

Cleanliness and sanitation are preventives. Rub the affected parts with an oil of an animal or vegetable nature or with vaseline. Application when first noticed will quickly rid the bird of the trouble. Should it be allowed to develop, long treatment is necessary. A developed condition of scaly leg denotes mismanagement.

Kerosene applications are very stringent and not advised, but if used care should be taken to see that the kerosene does not touch the skin above the shank.

Tumours.—Tumours are new growths which may be found internally or externally. They occur frequently in old poultry and are seen more in hens than in the males. They may be simple or malignant. Simple tumours may be excised, after which the wound heals, but malignant tumours have a tendency to spread to another part of the body. The cause is not known for certain and the birds should be killed as there is no cure.

Tick.—One should say that in Western Australia this is the most drastic parasite on poultry. Its damage is not noticed until the birds become extremely weak, showing a greenish diarrhoea, but once the general history of its life cycle and habit is known, it is easy to eradicate. Its tenacity to life is amazing. Cases have been known where adult tick have lived without food for years. The preferred hosts are fowls and turkeys, although geese, ducks, and pigeons also are attacked.

The amount of blood they draw from fowls is enormous, but the worst feature associated with tick is the loss caused by their being the agent through which tick fever is spread. This fever is due to the tick being infested with a microbe which is not detrimental to it, but when the tick are feeding this microbe makes its way, through the punctures caused when feeding, into the body of the birds, inoculating them with spirochaetosis, or tick fever.

The life cycle from the egg is roughly as follows: The female may lay many lots of eggs, each laying being followed by an engorgement of blood. The average laying is near 600 eggs. On hatching, the seed tick crawl on to the fowls and attach themselves in clusters on the birds, usually on the breast and under the

wings. They then gorge themselves with blood, and within three to five days fall from the host and search for a suitable hiding place. From then on they feed only at night, returning to their hiding places at daylight.

The adult tick vary from one-fifth to three-eighths of an inch in size. During hot, dry weather they develop quickly, but during cold spells they are inactive. They are hard to destroy once they obtain a hold in the farmyard. As they only emerge at night, the tick are seldom suspected, but their possible presence should always be uppermost in the mind of every poultry farmer.

The periodical cleaning of the sheds and perches and a close examination of all cracks will help to determine the presence of tick before any disastrous results have been felt.

The easiest method of tackling the trouble is to saturate all cracks with Flezol when building and paint all woodwork periodically, taking care that any trees having open bark are also treated. When tick have a hold it is necessary to keep sheds thoroughly clean of manure. Wedge open all joints and spray the Flezol between each joint and crack, spraying from both sides. See that all the woodwork is saturated and do not forget the laps in the corrugated iron. Repeat that treatment at fortnightly intervals and the trouble from tick will abate.

Symptoms in a fowl yard are dullness, prostration, ruffled feathers, lack of appetite, rapid wasting, dirty green and yellow diarrhoea and pale combs.

Fowls that have recovered from an attack of tick fever are immune, giving the owner a false sense of security. These birds if still housed in a tick-infested house suffer the drainage of blood, which causes a loss of eggs but show no other marked effects.

Should the owner introduce birds from a clean farm it is most noticeable that the new birds are immediately stricken down with fever and die within a day or two. Such a happening is about the surest sign of the presence of tick, but in to many cases the previous owner of the dead birds has been blamed for disposing of sick stock. Always have a rag tied round the perch or perches, and frequently examine the rag for tick.

Vent Gleet or Cloacitis is a contagious disease common to poultry. The first sign of this disease is the frequent passage of small quantities of faeces, showing severe irritation of the cloaca. The cloaca is congested and will eventually extend to the margin of the vent, which then becomes swollen, red and hot.

At first there is a watery discharge which afterwards gives way to a thick yellowish offensive discharge at the vent which collects and mats the feathers surrounding the vent. There is a very offensive odour accompanying this disease. This disease increases sterility in a flock and there is a marked increase in the infertility of the eggs as well as a distinct fall in the egg yield.

The male should be separated and it is not advisable to treat the bird or birds affected.

If it is desirable to treat, syringe the cloaca with a solution of permanganate of potassium (1 part to 100 water), bacterol (1 to 200), nitrate of silver (1 to 100) twice daily and the outside of the vent should be bathed with this solution.

Vent Gleet is a specific malady and cannot be suddenly checked. I would advise that all birds affected, together with the mate which has been in contact, be destroyed immediately.

Vitamin "A" Deficiency.

This vitamin is present in practically all green feeds so that if plenty of grass is available, no trouble should be experienced. When green feed is not available, and such is the condition in most of the country districts during the summer period, trouble may occur.

The symptoms of Vitamin "A" deficiency are quite pronounced. First there is a watery discharge from the eyes and nose similar to catarrh, followed by a deposit within the eye which can easily be removed. In the mouth and throat will be found small round nodules projecting within the mucous membranes. Emaciation follows and the bird weakens and finally dies.

Its characteristic in comparison to roup is that it does not eject an offensive odour, and the deposit in the eyes is of a greyish colour. The presence of the nodules in the digestive tract are also definite. Two per cent. of cod liver oil in the ration will prevent this disease. Should the farmer at any time be short in green feed supplies, it is always advisable to use cod liver oil.

Vitamin "D" Deficiency.

Vitamin "D" is present in most green foods, cod liver oil and a variety of other foods. This deficiency causes rickets and leg weakness. It is a common complaint with young stock which have been kept in enclosed sheds. Sunlight is a source of supply of this vitamin, therefore see that young stock have access to the health-giving rays of the sunlight besides feeding plenty of green feed.

Mineral Deficiency.

While several minerals are necessary for the growth of a bird the most common deficiency is in the calcium. Insufficient supply of easily assimilated lime will cause leg weakness, poor bone formation, crooked breasts and misshapen bones. Stress must be laid on the necessity of having available a plentiful supply of bone-forming material. No bird can make strong bone unless it is supplied in the ration.

Turkeys, which are naturally big boned birds, require a continuous supply of calcium during the growing periods. It is no uncommon sight to see birds with twisted legs and weak ribs and breast bones due to the farmer not realising the necessity of adding bone-forming meals to the feed.

Wheat is a good food on our farms, but wheat alone will not grow turkeys. We must realise that turkey farming needs as much care as any other poultry and they must be fed a ration containing meatmeal and bonemeal.

Worms.

Symptoms.—Wasting away, loss of appetite, ruffled plumage, mustard-coloured droppings, sometimes tinged with blood. Always be on the lookout for worms. These are of many species and they should be treated with the proprietary mediums or by the use of Black Leaf 40, as follows:—

Use ½ ounce Black Leaf 40 (one tablespoonful) to each 250 grown fowls. Mix this with 1½ gallons of water, then dissolve 3 lbs. of sugar in the water. When the suggar is thoroughly dissolved, use this 1½ gallons of mixture to mix 20 lbs. of growing or laying mash; more fresh water may be added if necessary. A feed should be omitted before giving the mash containing Black Leaf 40. This mash is fed in the morning and no more feed is given until evening. ¾ lb. Epsom salts is put in each 2½ gallons drinking water and left there until it is all consumed. Young stock averaging 2 lbs. live weight should have the ½ oz. Black Leaf 40 mixture to each 375. As Black Leaf 40 is poison-

ous, the above quantity should be strictly adhered to. Some poultry-farmers are following the above treatment with 1 per cent. tobacco dust in the mash weekly for three or four weeks.

Remove and burn all droppings after giving medicines for worm troubles.

White Comb or Fauus is an infectious disease of poultry. There is a white scurf or scales on the comb and face which will, if not checked, spread all over the body. The first symptoms are small white spots which run together. After a while this coating dries up and a rough dirty crust is noticed. The disease spreads until one notices the feathers falling from the neck, which then takes on a scabby appearance. Paint the affected parts with zinc or mercurial ointment and disinfect the houses thoroughly.

The mercurial ointment is made up of 1 part of red oxide of mercury to 8 parts of lard, and the zinc ointment is 1 part zinc, 1 part lard and 1 part olive oil.

Prevent the Introduction of Disease.

When any fowl is bought, it should be isolated for at least three weeks before it is allowed to mingle with the flock. Many a new bird has brought trouble to the new owner, owing to his not keeping it apart from the rest. First see that the bird is clean about the head, comb and wattles, free of sores and warts.

Open the mouth and look at the throat and under the tongue; take note of the hen's breath, it should not give off any offensive odour.

Examine the eyes. They must be dry with no bubbles in the corners. The nose must be clean and free for breathing purposes. The earlobes must be clean and free from warts, etc. Feathering should be tight and there should be no bare patches. Bare patches denote parasites. The crop should be empty after a journey. A full crop is a bad sign. The breast should be straight and free from scales. Vent feathering should be dry and free from lice eggs. A healthy back region is fluffy and clean. Legs must be clean—look for scaly legs.

The above are a few of the troubles of the beginner in poultry farming. A constant lookout for any ailing bird will save an enormous amount of trouble and distress.

On noticing an ailing bird, immediately catch and separate it from the rest of the flock—it is a source of danger. Never kill a fowl without opening it to confirm your opinion of the cause of the death. The practice of burying or otherwise disposing of dead birds without knowing the disease from which they died, gets one nowhere and is the cause often of having a later epidemic. If one were to post-mortem each dead fowl and ascertain the cause of death, one could then be prepared for trouble should one find a death due to infectious or contagious disease.

To post mortem.—Place the bird to be opened on a table, breast upwards. Cut off both legs and clean the skin with the feathers from the breast bone. Insert the operating knife between the last rib and the breast bone and cut towards the neck. Do this both sides of the bird. Pressure on the breast bone forcing it upwards and backwards will break the bone near the neck and expose the whole of the inside of the bird. Care must be taken to ensure that no damage is done by cutting the external organs while preparing the carcase

for internal exposure. Circle the vent with the operating instrument, taking extreme care not to damage the intestine, carefully untangle the intestines and withdraw carefully until the whole is laid out clearly beside the bird.

On examining the intestines upwards from the vent, one will find two blind branches to the intestines running in a downward direction. These blind branches are called the "cæca."

Examine the liver and note its colour. It should be a blood-red colour, not yellow. See if it is large or small. Note its texture when cut. Look to the condition and size of the heart. See that the lungs are salmon pink, not congealed with dark blood nor hard to the touch.

Intestines.—Open up intestines and look for any inflammation or blood coloured portions.

Gizzard.—Open this and see if you can see any inflammation therein. Note the contents of the *crop*—clean or sour food and water.

General Condition.—Note whether the bird is fat or in poor condition. It has a great bearing on the resistance to disease. Look for lice and other parasites. Note the general colour of the internal membranes. They should look healthy and not discoloured.

By way of comparison, when you kill a bird for eating, examine its organs with a view to knowing just what a healthy bird is like. You will then have an idea what is abnormal when you post-mortem a fowl which has died from an unknown cause, and lastly, when you have made your examination and want advice, do not forget to forward all the information you have gleaned when you have post-mortemed that dead bird and examined it.

(*To be continued.*)

By Authority: FRED. WM. SIMPSON, Government Printer, Perth.

METEOROLOGICAL INFORMATION.

Stations.	Temperature.				Rainfall.		Temperature.				Rainfall.		Temperature.				Rainfall.	
	Maximum.		Minimum.				Maximum.		Minimum.				Maximum.		Minimum.			
	Mean.	Highest.	Mean	Lowest.	For Month.	Average.	Mean.	Highest.	Mean.	Lowest.	For Month.	Average.	Mean.	Highest.	Mean.	Lowest.	For Month.	Average.
	DECEMBER, 1935.						JANUARY, 1936						FEBRUARY, 1936.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	87·4	104·8	59·1	47·0	0·06	0·27	91·8	107·3	63·2	50·9	*Nil*	0·30	93·1	108·0	63·3	53·7	0·03	0·41
Geraldton	79·7	101·8	60·9	50·0	*Nil*	0·16	82·9	105·3	66·6	55·2	*Nil*	0·23	84·0	101·1	64·4	54·8	0·02	0·28
Walebing	88·1	105·0	57·3	42·5	0·08	0·46	92·2	107·8	60·7	48·1	0·14	0·36	91·6	107·0	61·1	48·4	0·02	0·49
Perth	79·0	94·5	59·5	50·0	0·43	0·55	83·2	104·6	63·7	56·0	0·26	0·34	84·2	103·6	62·9	52·2	*Nil*	0·41
Kalamunda	82·4	95·0	56·6	46·5	0·61	0·74	82·8	101·8	60·7	52·5	0·38	0·51	84·6	102·0	59·8	49·2	0·02	0·58
Bunbury	76·5	91·8	55·6	45·4	0·29	0·56	78·8	90·2	60·8	49·0	0·44	0·43	79·8	98·6	58·1	47·4	0·16	0·52
Bridgetown	85·0	103·0	49·6	40·0	0·54	0·77	83·6	99·0	53·9	44·0	0·45	0·55	85·3	102·0	50·9	37·0	0·15	0·61
Albany	69·7	79·0	56·8	45·9	1·69	1·19	72·3	84·0	63·0	53·9	2·43	0·85	74·0	83·0	59·3	52·1	0·25	0·92
Merredin State Farm	89·3	105·6	58·3	43·1	0·21	0·52	92·3	105·9	61·6	51·1	0·98	0·48	91·5	106·0	62·4	48·5	*Nil*	0·50
Northam	89·0	105·4	58·8	42·0	0·04	0·34	91·2	112·7	62·4	52·0	0·19	0·32	91·9	107·0	61·8	50·0	*Nil*	0·38
York	87·6	103·0	57·2	41·0	0·13	0·40	89·8	105·0	61·7	51·0	0·22	0·32	90·2	105·0	60·7	48·0	*Nil*	0·43
Narrogin State Farm	85·8	100·0	51·5	39·9	0·08	0·54	86·5	101·0	57·0	46·7	0·72	0·37	...	...	...	...	...	0·50
Katanning	83·9	98·0	52·8	46·8	0·20	0·61	83·8	99·0	57·2	50·0	1·03	0·38	84·8	102·7	55·4	47·0	0·37	0·54
Cape Leeuwin ...	70·2	80·0	58·5	51·2	0·60	0·82	73·8	81·0	62·0	58·0	0·75	0·64	73·6	81·0	61·6	54·0	0·21	0·83

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